ELECTRONICS Australia

December, 1968

Incorporating RADIO, TELEVISION & HOBBIES

Vol. 30 No. 9

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30c

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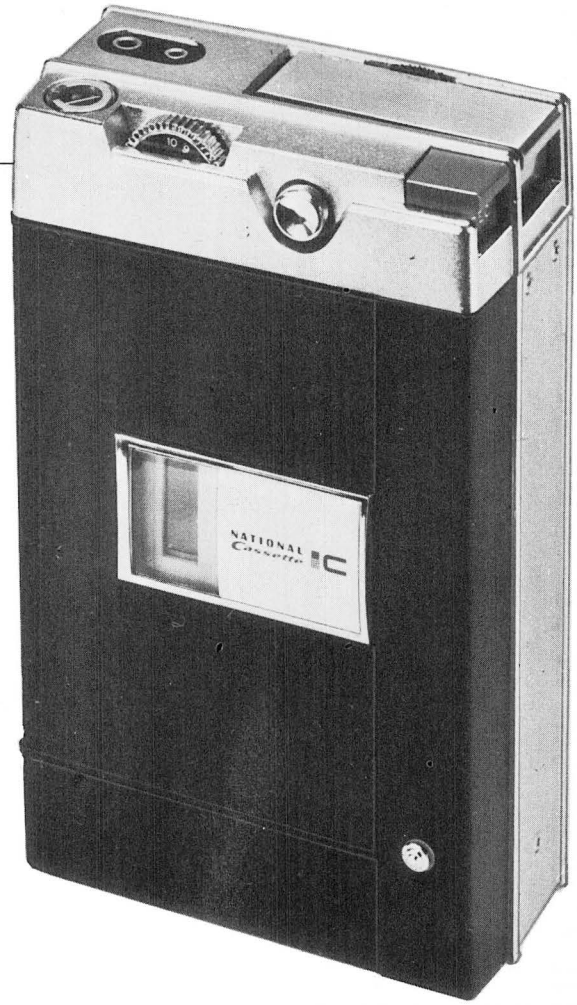

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Tickling the Tapes . . .

The gentle art of embezzlement has been practised ever since one man has had money to entrust to another. While many have "got away" with it, the risk of detection has remained high, because conventional books and documents can be scrutinised by anyone having access to them.

Over the past few years, however, a very different situation has arisen. Not only has the number of business transactions multiplied, but a substantial proportion of all transactions is being effected, not by documents and books of account, but by computer-oriented business systems. And, recorded as punched or magnetic patterns on cards, tapes and discs, the information is not easy to scrutinise. In fact, computer methods are so incomprehensible to traditionally trained managers and accountants that they often have to rely heavily on electronic data processing operators for both the execution and the auditing of accounts.

Not surprisingly, the temptation to "tickle the tapes" or to "cook the cards" has proved too strong for some and a recent news item has mentioned two specific cases in New York. They are probably not unique to that city. In one, the data-processing manager of a brokerage firm instructed the computer to write cheques to fictitious persons, all sharing his home address. Five years and $80,000 later he was found out, not by the auditors, but because of a postal delivery mistake!

In the other case, an executive helped himself to $250,000. The auditors knew something was wrong and presumably knew who was responsible but, until the executive himself explained the method, they were unable to find out how the swindle had been worked.

Seemingly, it is another example of human frailty that, having devised equipment capable of handling data many times faster and more accurately than before, it has become necessary to devise management procedures which will make it more difficult for those who understand it to manipulate it to their own ends.

How rapidly each Christmas seems to follow the one before. Sincerely do we extend the compliments of the season to readers and advertisers.

W. N. Williams

December, 1968

COVER PICTURE: An array of instruments in the cockpit of a BAC One-Eleven airliner. The pilot is indicating a standby artificial horizon developed by Ferranti Ltd., of Bracknell, Berks., England. Containing its own gyro, it provides an unambiguous linear display of pitch and roll attitude up to plus and minus 85 degrees from normal.

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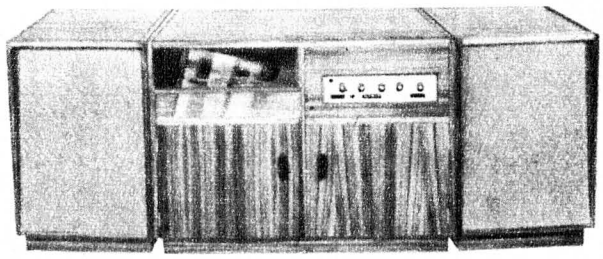

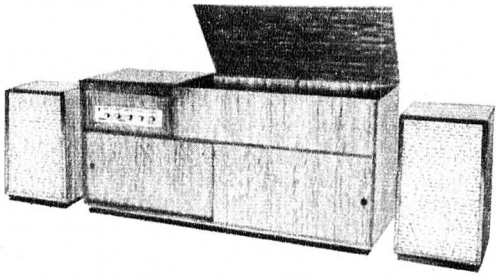

Here's another splendid selection. Take Instrol Model 375 R.S. Cabinet, with two Wharfedale Super 10 Speakers fitted into Instrol Vented Enclosures. The cabinet work may be Queensland Maple, Teak or Walnut. For your amplifier, what better than Instrol, solid state Model 20-20, or Kenwood TK150 or Instrol Model AT1 Amp-Tuner, Add Sony TC255 Tape Deck, and Dual 1015 (with Shure M44MG magnetic cartridge). Cost, within the range of $690.00 and $731.00. The same systems, but without tapedeck and fitted in Instrol Model 250 R.S. Cabinet, between $453.00 and $494.00.

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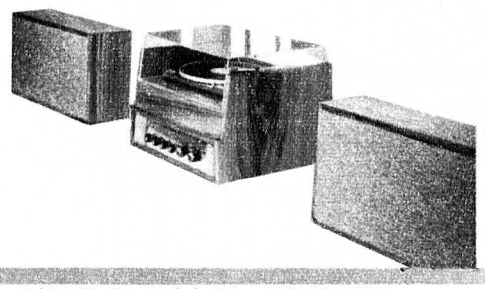

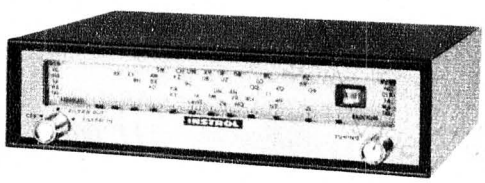

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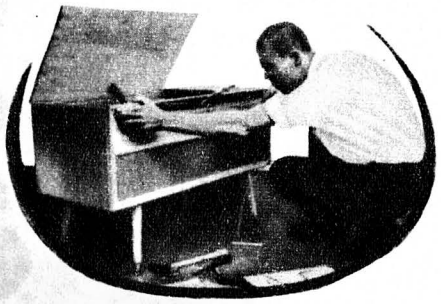

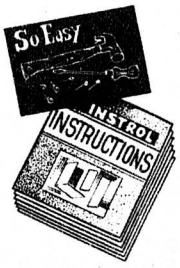

So easy, a child can manage it. The Instrol way — a new simplified method of assembly. A hammer, screwdriver, few hours of your time, and you can make for yourself a complete high quality hi-fi cabinet setting, fully professional in appearance.

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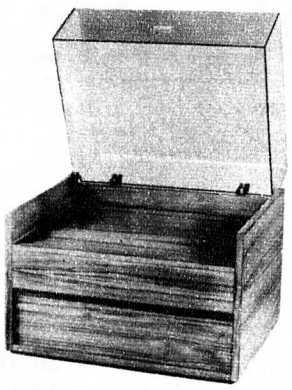
Each kit is complete with all necessary timber parts, plus nails, screws, full, easy to follow instructions. Speaker enclosure kits are complete with acoustic Inner-bond lining felt, and acoustic grille cloth. Equipment cabinet kits include hinges, knobs, catches, sliding stays, castors, slides, leg sets, etc. All timber parts precision cut, fit together smoothly . . . panels are best quality veneered in selected Teak or Queensland Maple. Instrol cabinet designs will cater for virtually any make of speaker, player, amplifier, and tapedeck. If required, all designs are available ready built and polished, but it's highly economical and much more fun to make your own.



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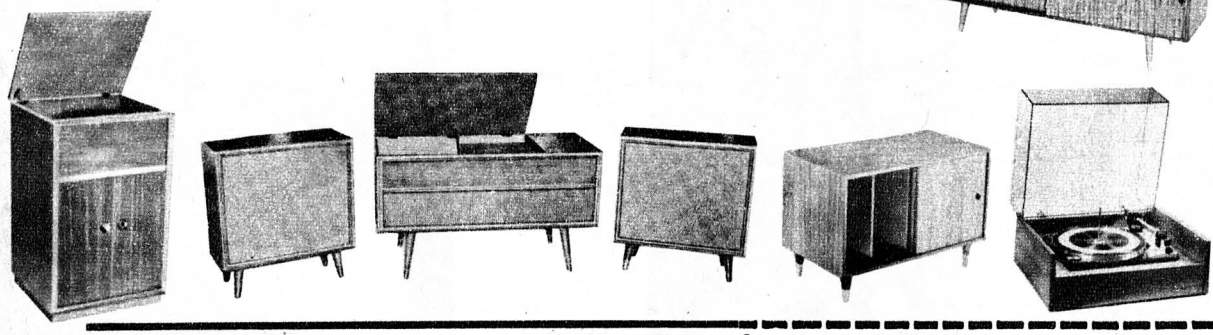
Kit of Parts, Teak	**$29.50**
Qld. Maple	**$26.00**
Built and Polished, Teak	**$38.40**
Qld. Maple	**$34.20**



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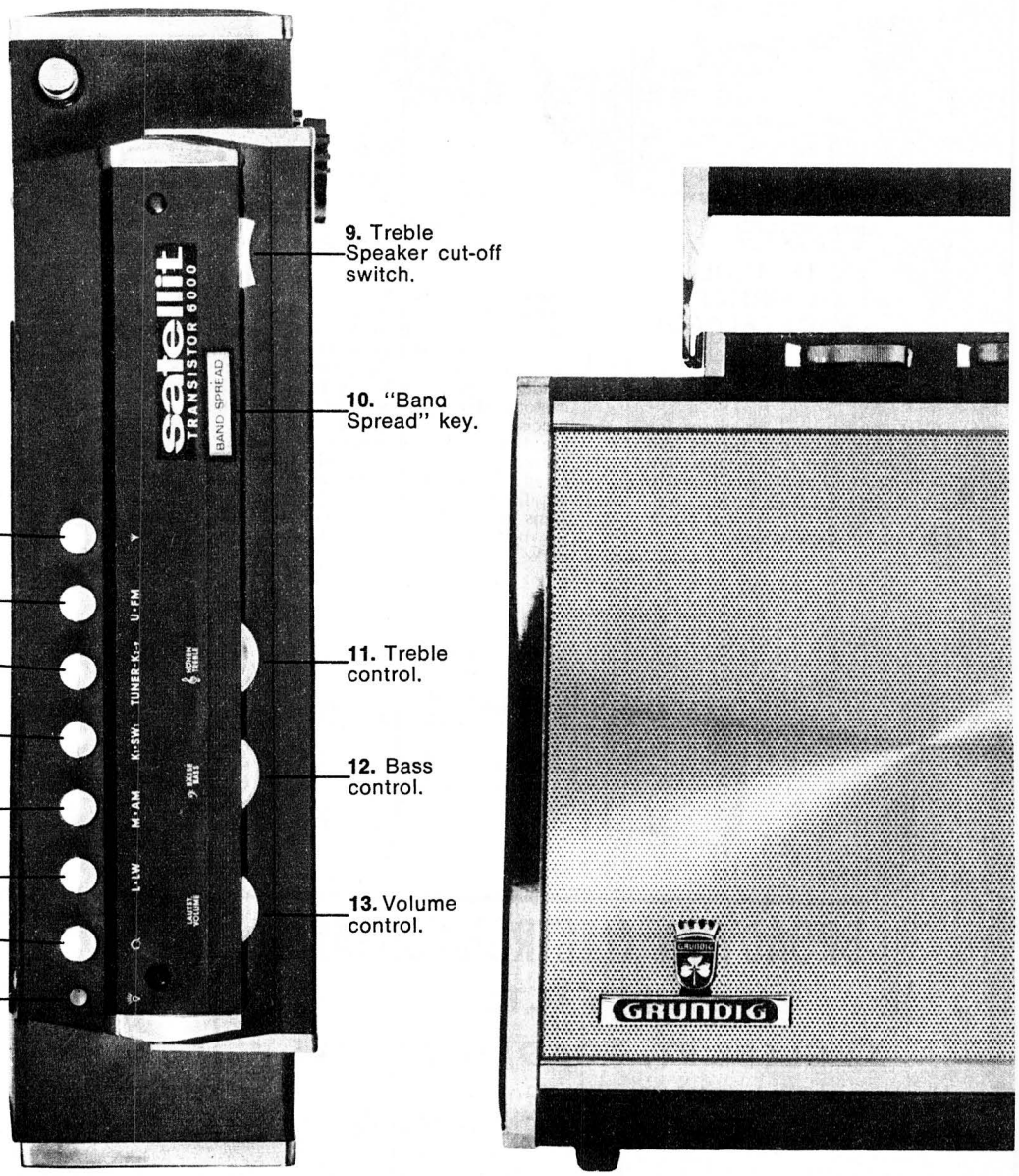
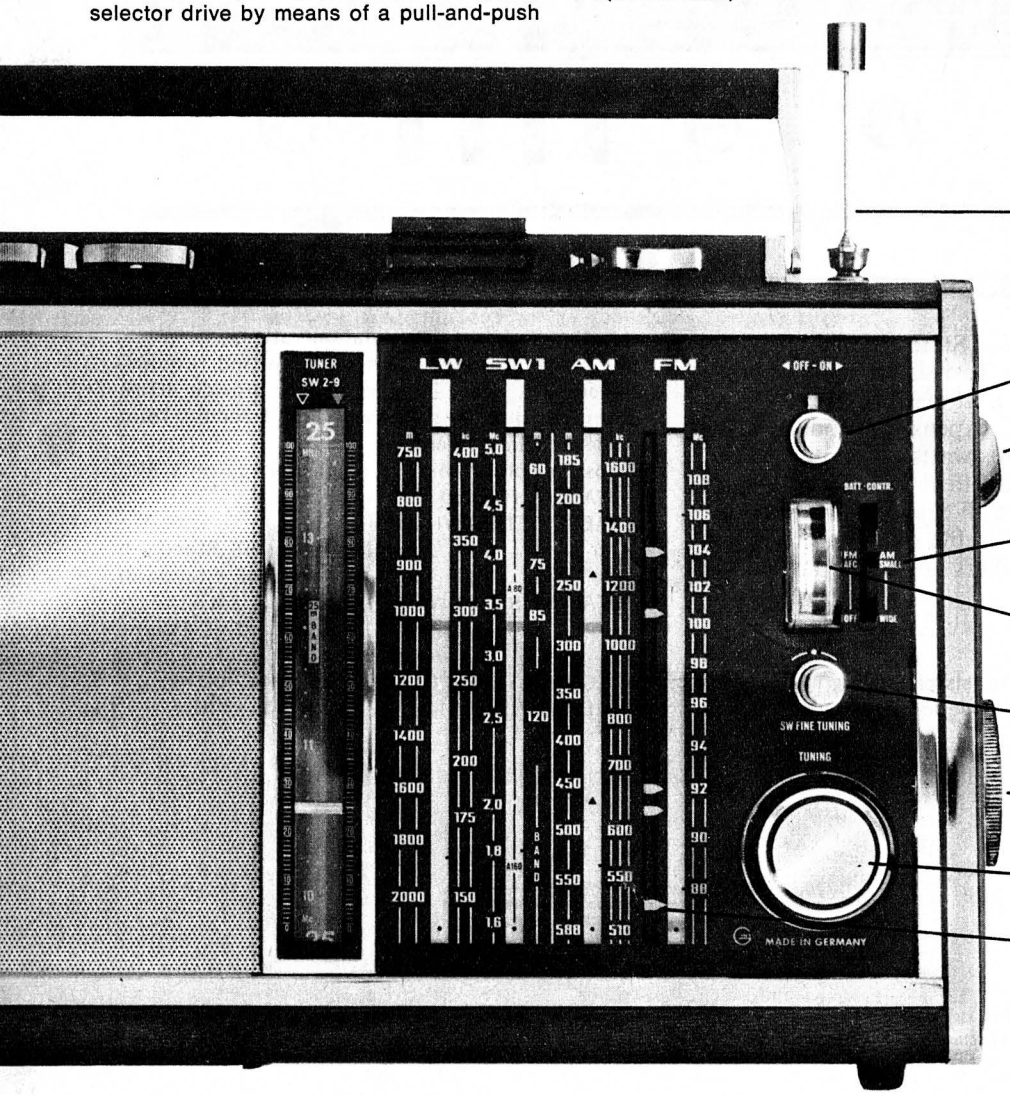


GRUNDIG Transistor 6000

Technical Specifications:

20 tuning ranges: FM, 17 x SW (SW 1: 60-187 m, SW 2: 42-60 m and 49 m band, SW 3: 36-50 m and 41 m band, SW 4: 26,5-37 m and 31 m band, SW 5: 21,5-30 m and 25 m band, SW 6: 16,5-24 m and 19 m band, SW 7: 14-20 m and 16 m band, SW 8: 12-16,7 m and 13 m band, SW 9: 10-14 m and 11 m band), Medium Wave (AM) and Long Wave • circuits: FM 14 (3 can be tuned), AM (without SW Tuner) 9 (3 can be tuned); SW Tuner 14 (3 can be tuned) • 19 + 1 transistors (17 of these are silicon trans) • best possible cross modulation by field effect transistors • 14 + 2 diodes • tuned-in first stage on all ranges • double superimposition of SW Tuner with 4-circuit band filter • gain control: AM 3-stage, SW Tuner 3-stage with additional control, FM 1-stage • ferrite aerial for MW (AM) and LW; MULTI-MATCH telescopic aerial for FM and SW (switchable) • DUPLEX Single Selector tuning • separate SW rotating drum selector drive by means of a pull-and-push tuning knob • colour marks for station tracing • SW fine tuning for SW 1 • "Band Spread" key • switchable AFC on FM • AM band width selector switch • tuning indicator (S-meter) • battery voltage indicator • 2 Superphone speakers (treble speaker can be switched off) • bass and treble control • 2 Watts push-pull output stage • battery operation by 6 x 1,5 V mono cells • built-in mains power pack TN 12 • dial scale illuminated • sockets for external power supply, earphone, external speaker, outdoor aerial, car aerial, outdoor dipole antenna, ground, record player/tape recorder • receptacles for SSB device with switch-over to manual control, sound filter, product demodulator • cabinet: wood, w/leatherette covering, in black and walnut.

Size approx. 44 x 26 x 12 cm
(= 18½" x 10¼" x 5")
Weight (incl. power pack), approx. 6.1 kg (w/out batt.)



14. MULTI-MATCH telescopic aerial for FM + SW reception.

15. On-Off Switch.

16. Range selector switch (SW Tuner).

17. Switch for AFC on FM, band width selector and battery voltage control.

18. SW fine tuning indicator and battery voltage indicator.

19. SW fine tuning (SW 1 range).

20. Station selector for SW Tuner.

21. Station selector for FM, SW 1, MW (AM) and LW.

22. Slide marks.

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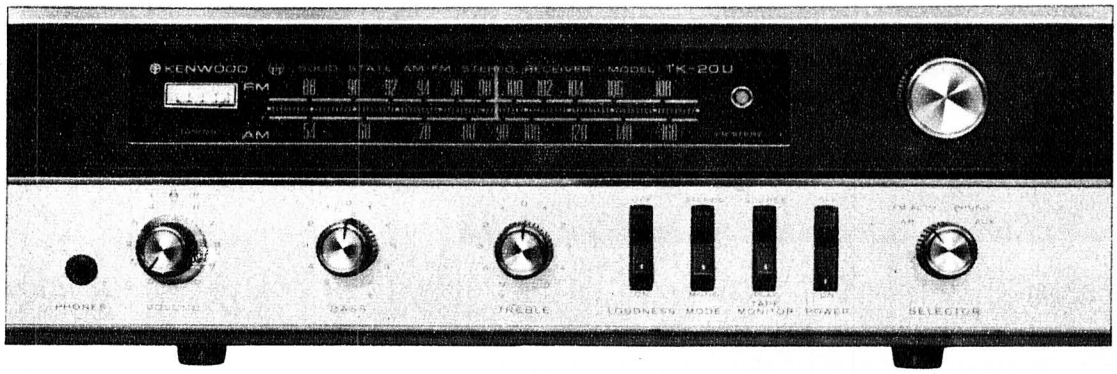

30 WATTS SOLID STATE FET AM-FM STEREO RECEIVER TK-20U

The TK-20U Solid State Stereo receiver powered by Silicon Transistors is reasonably priced (Aust. $219). It performs equally as well as the more expensive models. The features include 30 watts of total music power, (F.E.T. Field Effect Transistor) 3 gang tunging condenser, 5 IF Stages and a magnificent bass and clean treble sound. For greater power, other amplifiers are readily available.

▼ TK-20U

*F.E.T. (Field Effect Transistor) 3 Gang Tuning Condenser frontend for superior sensitivity, image rejection and cross modulation ratio.

*5 IF stages with 3 limiters and wideband ratio detector have been incorporated to provide 40 dB alternate channel selectivity and freedom from noise and interference.

*4-position program source selector permits AM, FM AUTO, PHONO and AUX.

*USABLE SENSITIVITY:
FM: 2.5 microvolts (IHF Standard)
AM: 10 microvolts (IHF Standard)

*TOTAL MUSIC POWER:
32 watts (IHF Standard at 4 ohms)
30 watts (IHF Standard at 8 ohms)

*FREQUENCY RESPONSE: 25 Hz—40,000 Hz

*DIMENSIONS: 14 1/16″(W), 4 3/4″(H), 11 1/4″(D)

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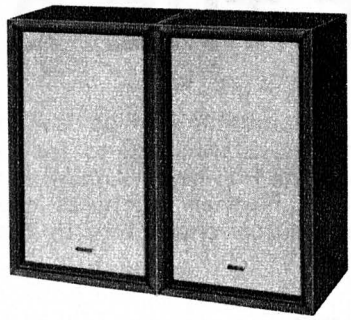
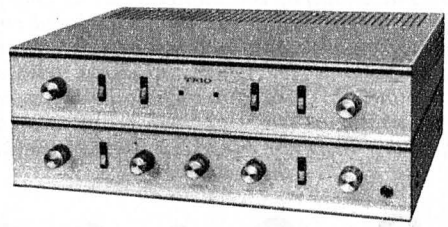


BOOKSHELF TYPE 4-WAY 5 SPEAKER SYSTEM KL-60

▼ KL-60
*60 watts input, 5-speaker, 4-way system
*Designed for use with solid-state amplifiers
*Four-step tone selection
*Completely sealed enclosure
*Smooth 4-way crossover
*Mounted speakers: 12-inch, free-edge woofer×1 (Bass)
6½ inch cone squawker×1 (lower midrange)
4 inch cone squawker×1 (higher midrange)
Horn-type tweeter×2 (Trebie)
*Frequency response: 30Hz to 20,000Hz
*Dimensions: 15″(W), 25½″(H), 11⅝″(D)

40 WATTS SOLID STATE STEREO AMPLIFIER TK-150U

▼ TK-150U
*40 watts of IHF Standard total music power
*All transistor amplifier provides wide 20 to 50,000 Hz frequency response and 20 to 60,000 Hz power bandwidth.
*5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
*Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
*Dimensions: 10¼″(W), 4⅛″(H), 9⅜(D).



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60 WATTS SOLID STATE STEREO AMPLIFIER TK-250U

▼ TK-250U
*60 watts of IHF Standard total music power
*Very low IM distortion for exceptional clear sound low level to high level listening
*High damping factor 23 (8 ohms), 46 (16 ohms) for excellent transient response
*2 sets of stereo speaker terminal and front panel speaker selector switch.
*Frequency response: 20Hz—50,000Hz (±1dB)
*Power bandwidth: 18 Hz—60,000Hz (−3 dB)
*Dimensions: 13″(W), 4⅛″(H), 9⅝″(D).

90 WATTS SOLID STATE STEREO AMPLIFIER TK-400T

▼ TK-400T
*90 watts of IHF Standard total music power to drive even low efficiency HI-FI speakers.
*Blow out free exclusive automatic circuit breaker protects power transistors (U.S. Pat.)
*NF type tone control.
*Frequency Response: 20 Hz - 50,000 Hz (±1dB)
*Dimensions: 15¼″(W), 5¾″(H), 12¼″(D).

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THE 2-NESS OF THE 2

At Britain's National Physical Laboratory, a group of scientists has devised a character-recognition machine which, among other uses, is intended to facilitate computer handling of customer accounts. A machine has been built which can recognise machine printed numerals of one fount. Further machines are planned which can recognise mixed founts and hand-written characters in the full alpha-numeric range.

by J. R. Parks and D. A. Bell

(National Physical Laboratory, U.K.)

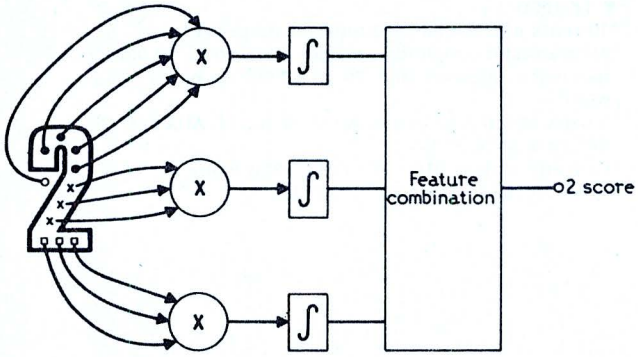


Figure 1: The shape of the numeral "2" is characterised by an open loop at the top, a diagonal running from top right to bottom left, and a horizontal line at the bottom. This diagram shows how an n-tuple combining these three characteristics can provide the analogue values of these property measures which are then combined by digital circuitry to give the score of 2.

Figure 2: Ideally, a machine should be able to recognise all these characters as the numeral 2. The machine so far developed can recognise only single fount characters.

As computers grow more common in our society, it is becoming increasingly important to have a system of easy communication between Man and machine. It has generally proved fairly easy to let a computer "talk" to the operator, by either a computer-controlled printer or a cathode-ray-tube display, but communication in the other direction has always been difficult. Punched cards, punched paper tape and specially printed magnetic ink characters on documents have been by far the most frequently used media. These are ideally suited to the computer's requirements but they are not at all convenient from the user's point of view.

Quite a lot of research has recently been devoted to the development of machines which are capable of reading "ordinary" typescript. The advantages of this development are mostly to be seen in the business world, where masses of information accumulate in the form of invoices remittance slips, tally rolls from cash registers and so on, all easily readable by human beings, but quite useless to a computer in this form.

The anomaly is particularly obvious if one considers the case of, for instance, a reminder for a hire purchase payment. This is produced on a computer output printer and sent to the customer, who returns it with a cheque for the appropriate amount. It is now necessary to update his account in the computer's magnetic tape file, but, instead of simply letting the computer "read" the bill and the cheque and take the appropriate action, the information has to be entered manually by a punched card operator and then read into the computer by a conventional punched card reader.

Some considerable progress has already been made on systems in which the printed characters are specially designed for easy recognition by machine. The curiously shaped numerals found on the bottom of cheques are of this type. They must, however, be printed in a special magnetic ink to a very high degree of accuracy as regards size, shape and tilt, unlike ordinary typescript in which small differences between nominally identical letters may be noted without difficulty. For example the small loops in Bs, Rs, etc., tend to fill in, and the crosslines of letters like H and A become fainter than the rest of the character. In addition, the criss-cross pattern of the linen printer ribbon appears as a background (see figure 4).

To a human reader, an A is "quite different" from a B, but to a simple electronic device an A typed on a typewriter with an old ribbon may look "quite different" from the same letter typed after the ribbon has been renewed. Clearly the first difference is much more significant than the second, and any character-recognition machine must be designed to treat the first difference as significant and ignore the second.

A printed character is a two-dimensional object, and as such is awkward to deal with electronically. The usual approach is to scan it in a series of lines after the manner of a TV picture. The resulting video signal may then be processed as an analogue (continuously varying) voltage, or converted into a "black-or-white" binary signal and used, for example, to set each of a matrix of switches on or off. A variety of techniques is available for recognising the signals. A simple method is to use a mask for each type of expected character. The unknown is compared with each of the possible characters by superimposing it over all the masks in turn. It is then identified with the mask

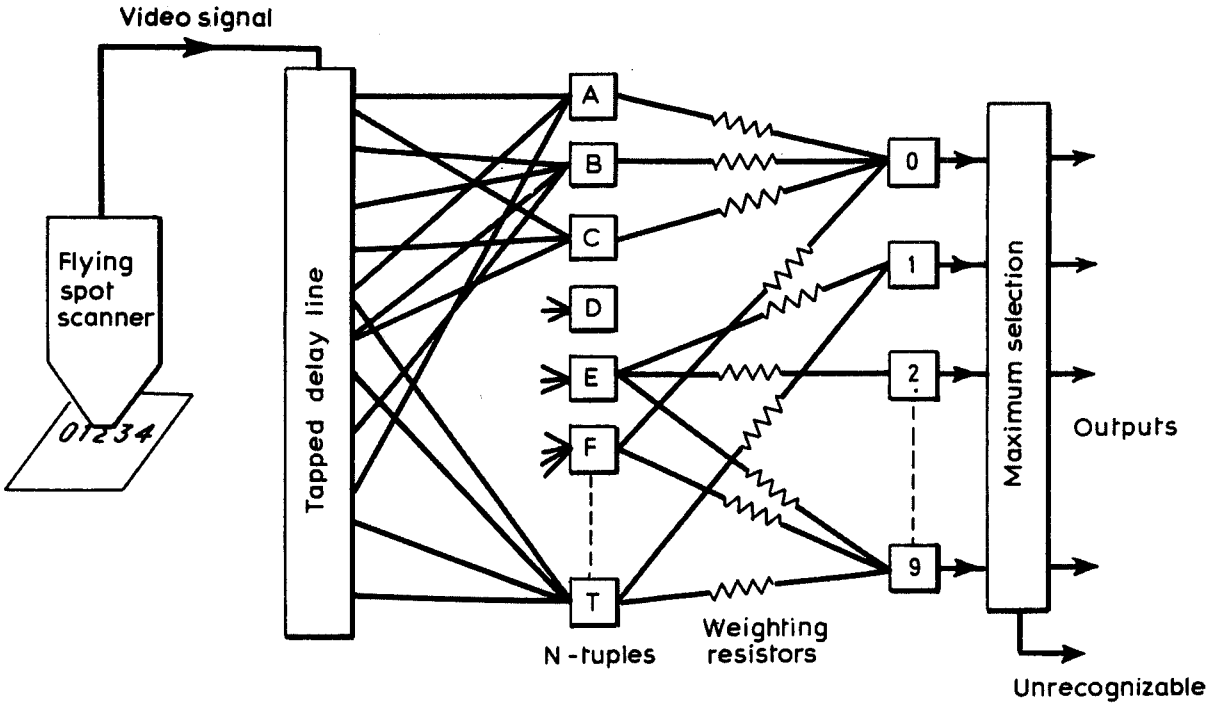


Figure 3: The main features of the Cyclops character-recognition system. Combinations of variously delayed signals form the n-tuple readings, and each character will produce a maximal signal from a particular combination of n-tuples.

giving the best fit. The chief drawback of this method is that the character has to be superimposed quite accurately upon the mask and this is difficult and expensive to do automatically.

Another method follows the outline of the character and defines its edges, going up one side of the strike and down the other. This approach shows great promise as far as handprint recognition is concerned, since most people tend to write numerals without lifting the pen, but the print-hammers of a typewriter or high-speed printer often produce faulty characters which have breaks in the strokes, so that a simple edge follower could be thrown out of step.

The basic approach of the group studying character recognition machines at the National Physical Laboratory is that the geometrical nature of characters must be exploited, and that any technique explored must be capable of economic realisation as a hardware system which can deal with low-quality printing.

The insistence on the use of geometric properties of a character has led to the development of several techniques for detecting the constituent features of a character such as curves, straight lines, and corners.

The character recognition machines which have been devised at the National Physical Laboratory are called "Cyclops." This name was chosen as they are "one-eyed" devices, with single scanning apertures. However, this one aperture has several scanners, so that more than one character can be scanned at a time. This would be essential for numbers with multiple digits, representing sums of money.

The first system devised was called Cyclops I. This was capable of reading printed numerals at a rate of 3,000 characters a second. An extension of this system, Cyclops II, has been extensively studied by computer simulation. This second generation machine is capable of recognising the full alpha-numeric set of characters in upper case (capitals) without having to have the printed material separated into individual characters. The NPL researchers are now working on a further development known as Cyclops III, which is required to read hand written block capitals and mixed multi-fount printed characters.

A technique that was favoured at the National Physical Laboratory right from the start used a device known as the "n-tuple." For the sake of convenience, an n-tuple may be regarded as a fixed pattern of points which is laid over a character to determine whether the pattern of points coincides with the outline of the character or not.

In practice, a character is scanned by a flying spot scanner which converts the black and white pattern into a pattern of electronic signals. These signals are fed to a series of delay lines which present the rectangular image as a continuous line of information. This line can then be sampled at certain points to see whether signals are present corresponding to the points of the n-tuple pattern which identifies a particular character.

(EDITORIAL NOTE. A simple analogue will serve to make this process clearer. Let us suppose that the character is printed in black ink that is not yet dry, on white paper. A white thread is then laid over the rectangular area, containing the symbol, in a pattern similar to that which would be laid down by the spot of a flying spot scanner. If this thread is then stretched out in one continuous line it will be found to have picked up a black mark at every point where it has crossed the wet ink of the image.

The pattern of marks so obtained will be unique to a particular character outline, and if every point where a mark occurred were sampled there would be no doubt which character was involved. However, it can be shown that by skilful selection of certain key points on the line, the character can be identified with only a few sampling operations. The places where these points fall on the character image make the pattern of a particular n-tuple. Since the n-tuple is exclusive to a particular character, it follows that a separate n-tuple is required for each individual character involved in the recognition process.

We can now see how the pattern of electronic signals in the delay line can be sampled by a series of take-off points t_0 see whether image information is present at the points corresponding to a particular n-tuple. If it does, then the Cyclops machine registers the presence of that particular character.)

Greater shape discrimination may be achieved by including more points in the n-tuple. It is also usual to have "negative" points, which must NOT fit on the character. For example, if a negative point is inserted where the minus signs appear in figure 5, then 3, 5 and 7 still give good fits but the 6 now gives zero fit since the negative point lies squarely on the character. In fact, about 20 different point patterns, with 3 to 5 points each, are required to deal with the 10 numerals.

The advantage of using this technique is that the pattern of points may be regarded as being moved all over the area where the character may be expected to lie, and thus if the character is within the "window" of the scanner, a fit will be recorded if it exists at all. The method

of measuring the total fit of an n-tuple on a character is to integrate the response over the entire area containing the character.

Having subjected the character to several different types of n-tuple operation, a set of measurements is now available in the form of one for each n-tuple (typically about 20). These 20 numbers represent a condensed form of the total "information" contained in the printed character on the paper.

A figure may be put on the degree of condensation achieved, as follows. Suppose the original scanning of the character uses 20 vertical lines and produces about 800 distinguishable points, and that the "blackness" of each point can be resolved into 60 levels, equivalent to six binary digits or "bits." Thus, one may say that the character when scanned has an information content of 48,000 bits. After the n-tuple operation, this figure is reduced to about 100 bits (20 numbers of about 5-bit accuracy each). The final decision as to which numeral is present is a 1-in-10 choice, and the numerals 0 to 9 each have an information content of 3.3 bits.

It is therefore evident that a great deal of information must be thrown away when recognising a character, and it is most important not to throw away the baby with the bathwater. The problem of reducing a very large mass of information down to its bare essentials is really what pattern recognition in general is all about. The n-tuples, in particular, must be carefully chosen, so that each one makes a definite contribution to the total recognition effort.

In their "raw" form, the 20 or so n-tuple scores are not directly usable by the classifying section of the machine, but if they are combined together in the right ways, usually one combination for each class of character expected, they may be classified in a simple manner. In the case of printed characters of only one fount, it is normally sufficient to have as many combinations as there are possibilities of classification—10 in the case of the numerals—but if the characters sometimes appear in different forms, for instance in several founts, then more combinations may be required, one to deal with each peculiarity, such as open-top or closed-top "4"s. The character is identified with the combination of n-tuples which gives the largest total response.

The simplest way of combining the n-tuple scores is to take a weighted sum, where the weights may be positive, zero, or negative. A simple example may make this clear. Suppose three n-tuples are to be used to recognise the characters 1, 2 and 3. If the n-tuples (call them A, B and C) have the responses to the three characters shown in the table, then the combination identifying 1 might be (A minus C), the 2 combination (B minus A) and the 3 combination (C minus B). (It is possible that some improvement might result from taking weighted sums of squares, products or even higher terms.)

numeral	n-tuple		
	A	B	C
1	high	vague	low
2	low	high	vague
3	vague	low	high

It is instructive to see how these ideas are translated into electronic hardware. Figure 3 shows the main features of the Cyclops character recognition system. On the left is a flying spot scanner, which transforms the image of the character on paper into a continuous video signal. This video signal is fed into a series of delay lines; various parts of the video signal, separated from one another by fixed time intervals, are brought together into an n-tuple. There are 20 n-tuples, all using the same group of delay lines in different combinations, and the output of each is integrated over one scan of the character. A large matrix of resistors forms the required weighted sums of the n-tuples, corresponding to the numerals 0 to 9. These enter a maximum-selection circuit, which gives an output corresponding to the most probable choice of characters.

The system as contructed operates at a rate of 3,000 characters per second. The use of analogue processing techniques avoids the necessity of converting the grey levels in the printed character to black and white and enables us to recognise characters of poor print quality successfully. This is a most important characteristic, as most print is not black on white but darker grey on lighter grey, as figure 4 demonstrates.

There are two principal variables which require careful design if the Cyclops is to recognise characters correctly. One is the set of n-tuples; the other is the set of weighting

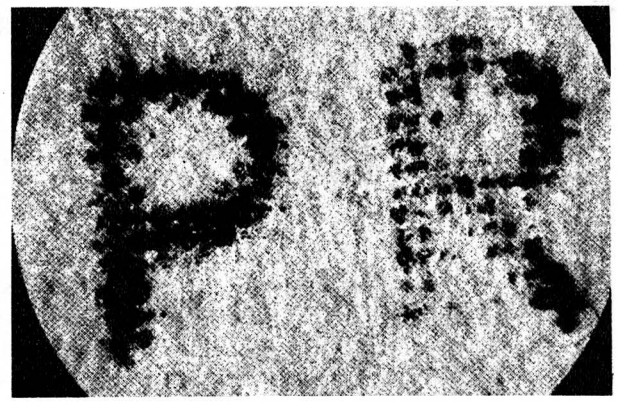


Figure 4: Typescript characters of the OCR-B standard fount. This is typical of the material that a reading machine must be able to recognise.

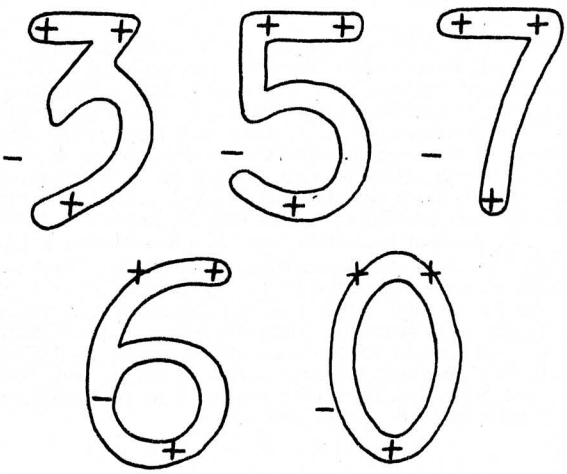


Figure 5: An n-tuple superimposed on a variety of numerals, showing how the position of the positive and negative points of the n-tuple in relation to the outline of the characters can distinguish some numerals from others.

co-efficients which combine the n-tuple outputs. These design considerations necessitate the use of high-speed digital computers for their solution, and an elaborate scheme of simulating parts of Cyclops and its successors by computer has been developed at the N.P.L. These facilities include a language for manipulating two-dimensional patterns in general, in addition to more conventional statistical routines.

The main value of the simulation facilities is in the ease with which variations in the system can be quickly and consistently evaluated. Unfortunately it is quite difficult to make the computer capable of extensive learning from past experience and of suggesting new lines of approach. The ability of the human experimenter to design n-tuples reflecting the geometric properties of characters is indispensable. But the computer is able to eliminate massive amounts of human labour which would otherwise be expended in sorting through the performance of large groups of n-tuple in the search for a "perfect" set, and in making small changes to improve the discriminating power of the set.

This demonstration of the combination of computer power and human intuition and intelligence to solve a problem emphasises the value of the symbiotic use of Man and computer for the resolution of complex tasks in which the objective is clear but the method of reaching it cannot be defined analytically.

Much of the work to date has been concerned with single-fount recognition, using the OCR-B fount (an ordinary looking type face for use on office and computer printing machines, with some features to help machine recognition—note, for example, the slight difference in the size of the upper loop of the capital P and R in figure 4. Develop-

(Continued on page 174)

DATA COLLECTION FROM APOLLO ROCKET TRIALS

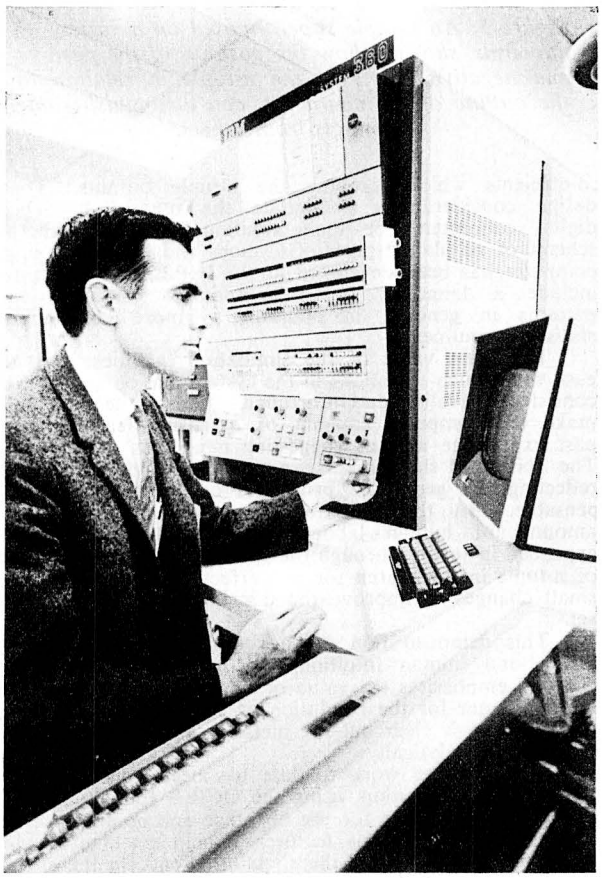
137-MILLION BITS A SECOND

When a Saturn rocket was sent into space last year as part of the U.S.A.'s Apollo program for a moon landing, data was sent back from the complex instrumentation carried in the rocket at the fantastic rate of 137 million bits a second. Boeing's Unified Flight Analysis System had the task of filtering, analysing and evaluating this mass of data.

by Ray Thomas

When, in 1926, Dr Robert H. Goddard launched the first United States rocket, there was no problem in evaluating its performance. The either/or technique was used. Either the rocket flew or it didn't. (It did: 2½ seconds.) Twenty years later, June 13, 1946, the first instrumented rocket in America—a captured German V-2—was launched at White Sands, New Mexico. This time, evaluating performance was more complicated. The V-2, actually the fifth to be fired in the United States but the first to be wired for sound, radioed back data from 30 measurement points.

Dr Wernher von Braun was at White Sands that day as head of an Army rocket team. Twenty-one years later, Dr von Braun, now director of the National Aeronautics and Space Administration Marshall Space Flight Centre, was at Cape Kennedy, Florida, as another rocket — this one as tall as a 36-storey building — rose from its pad. "Go, baby, go!" he called. It did, but this is no longer considered an adequate evaluation of success.



A Boeing engineer filters out "garbage" (unwanted noise) from data recorded on tape.

Dr von Braun was cheering the Apollo-Saturn 501, the launch system that will transport man to the moon. Just as rockets have become better performers through the more than 40 years since Dr Goddard's 1926 flight test, so has performance measurement become much more demanding and unbelievably complex. As 501 flew on that November day in 1967, its telemetry systems were pouring out 50,000 data bits each second from each of 2,740 measurement points. That's 137 million bits a second. All this data was soaked up by radio receiver antennas on the ground. And there it lay — more information than had ever before been gathered on a spacecraft launching. Was it more information than anyone could possibly use?

Years before it happened, one engineer, foreseeing the data avalanche, mourned, "How will we sort all of this? With a fork-lift?" No, not a fork-lift but computers, data processors, display scopes and human ingenuity.

Transforming this ocean of raw data into manageable document reports was the job of the new Unified Flight Analysis System (U.F.A.S.), designed and operated by Boeing in Huntsville, Alabama. U.F.A.S. completed the Apollo-Saturn 501 analysis and delivered the final evaluation report to the Marshall Space Flight Centre 21 days after the launch.

Why the speed? The 501 was the first Apollo-Saturn launch. NASA needed to know quickly if any changes were required for the next flight. U.F.A.S. melted the mountain into ingots of useful information and in time for them to be used. Just as this was the first flight for Apollo-Saturn, so it was for U.F.A.S. Both were successful.

The U.F.A.S. control centre is a 50-foot room divided into three distinct areas for data scheduling, distribution and retrieval. Nearby are other areas for receiving, reproducing and storing the data. Adjacent is the Boeing computer centre, the key to the entire system.

After Apollo-Saturn was launched, NASA's collection system — with receiving antennas spaced around the world — supplied reels of magnetic tape containing a dissonant symphony of flight information. Rushed to the Marshall Centre, the tapes were forwarded across town to the Boeing laboratory, alerted for an around-the-clock schedule.

"Altogether, we received 282 reels of tape," said Jack Scott, Boeing Huntsville flight data management chief. "From these we generated more than 2,000 analytic tapes to provide engineers with the material they needed. To do this within our schedule, we often had four computers in operation at the same time. Before the job was finished, we handled more than 500,000 individual pieces of paper — charts and graphs and such — and not a single piece was lost or misplaced."

The information on the tapes consisted of pressure and temperature readings, shock and strain measurements, power fluctuations and other flight facts engineers needed to judge success.

First stop at Boeing for an incoming tape containing raw data was the inspection console. Here engineers spotted and corrected potential trouble areas and converted the data into a standard "language" understandable to computers. Information on the tapes then was separated into several classifications and recorded on computer disks.

Next stop was data conditioning — smoothing it out

Completed data, identified by code number, is displayed on a board in Boeing's Unified Flight Analysis System Centre, Huntsville, Alabama.

by using a console with a graphic display scope similar to a television screen. Engineers can read through the data as it whirs through the computer. This computer theatre is, perhaps, the most spectacular technical innovation of the entire laboratory. "The engineer, mentally at least, is right inside the computer when he sits at the display scope," Scott commented. "The computer is looking at whatever data the engineer has asked for and is reproducing what it sees in chart form on a television screen. Not only this, but the computer prints comments at the bottom of the screen telling the engineer what steps he can take if he wishes to improve the picture."

Two-way communication between computer and engineer is done with a typewriter and a light pen. The viewer uses the light pen — a device containing a photo-electric cell — to touch the screen as directed by the computer. The machine immediately performs the additional steps it itself has suggested.

In this manner, Scott explained, tape "garbage" can be removed. "Garbage" gets onto the original tape in a variety of ways — engine noise and vibration, for instance, may affect instruments set to measure something else. Such unwanted information is dumped overboard either by touching the scope with the light pen or by filtering the facts through a mathematical formula. The filter is sent into the computer via a typewriter connected to the console. The result is an expurgated edition of a data tape. Nonsense is edited out; usable material is left in.

"Garbage" in the past has, at times, made whole data tapes worthless. Cost savings of the U.F.A.S. garbage-collection function alone have reached nearly $1 million.

Once the basic tapes have been passed by the inspectors and censors, the computation runs begin. Computer programs produce tens of thousands of analytical charts, each coded with the serial number of the spacecraft sensor which recorded the data in the first place. A console then prints out the charts and records them on coded microfilm. In this form, the finished data is distributed to the appropriate engineers.

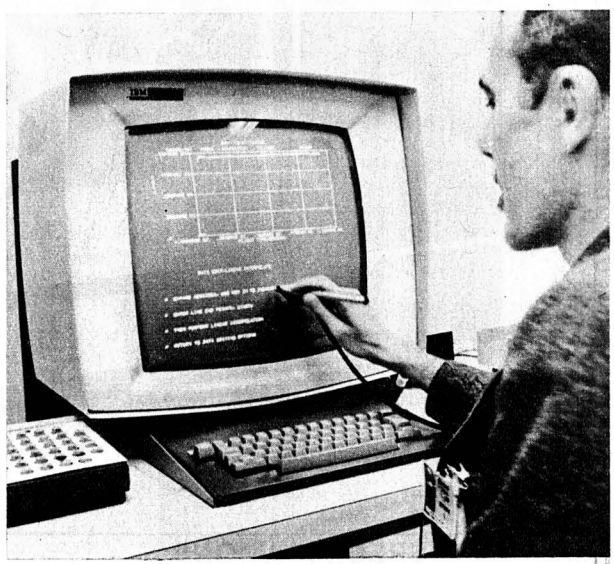
A massive schedule board covers one wall of the control centre room. Posted in sequence on this board is every step of the U.F.A.S. procedure master plan.

"You can compare this board with a rally car road-map," said Scott. "It not only shows you every milestone along the way and how to detour around roadblocks, but it shows you the exact time you're supposed to be in any one place — detours and all."

Although 21 days were allotted for completion of the flight analysis job for 501, the first Apollo-Saturn launch, the control board could handle a 26-day job. It is divided into 26 equal sections each representing one day. An automatic indicator is started when a launch begins and moves on down the board like a clock — which it is.

"At any time," Scott said, "we can look at the board and tell exactly where we should be in the analytical process. We call the indicator the 'moving finger of fate.'"

At one end of the room are magnetic bulletin boards on which to display and distribute the data produced by the computers. There are sections for each stage of the moon rocket, and for specific areas of information such as



Computers at the Huntsville centre show as part of their display appropriate steps which can be taken in the analysis of data. The engineer instructs the computer by pointing to the required step with a "light pen."

aerothermodynamics and structural loads. Each section is divided into hundreds of subsections, each unit bearing the code number of a specific measuring instrument on the rocket booster or its Apollo payload.

Engineers, knowing the instrument number they're responsible for, go to the designated spot and find their data waiting for them. Should an engineer wish to re-examine any data, the microfilmed information is projected on to screens in the time it takes to punch the code number into the console.

"With this microfilm file we don't need warehouses to hold the paperwork," Scott said. "We believe this system could have other company data storage and retrieval uses. Think what libraries could do."

When Apollo-Saturn 502 left the launch pad April 4, 1967, lab personnel swung into their round-the-clock schedule. The precision techniques proved themselves anew analysing upper stage anomalies.

One day the U.F.A.S. concept may help an astronaut solve a problem while he's streaking through space. Entire testing and evaluation programs could be stored on tape and be available for instant recall at the astronaut's touch of a code number. U.F.A.S. will process the information obtained on every flight of the Apollo-Saturn program. ◻

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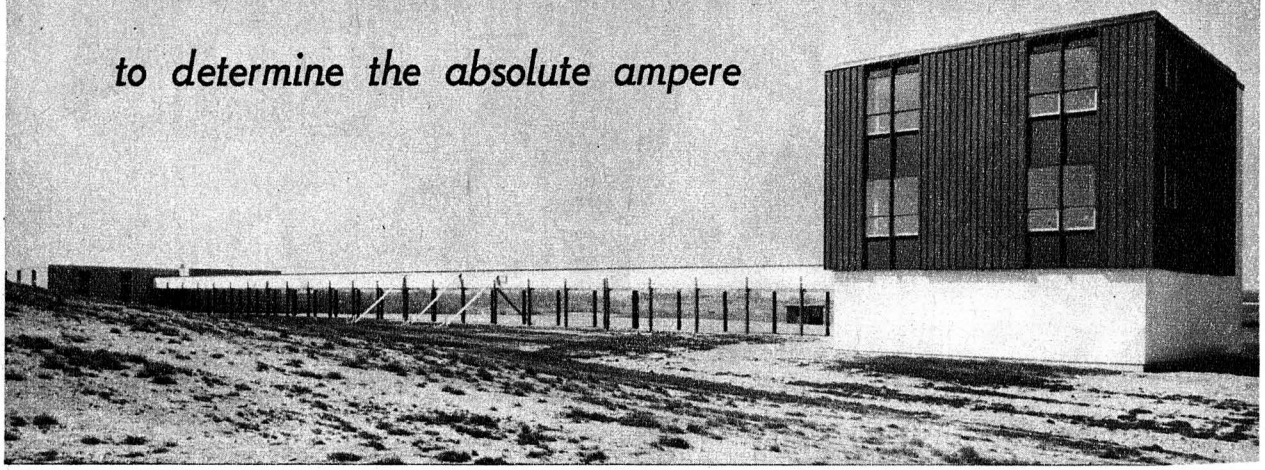

A new "non-magnetic laboratory," recently completed at the National Bureau of Standards in Gaithersburg, Maryland, U.S.A., houses apparatus for extremely precise determination of the absolute volt and the absolute ampere.

Magnetically "transparent" materials were used in the laboratory's construction so that highly sensitive experiments might be performed in the undistorted magnetic field of the earth. One of six special-purpose laboratories, comprising phases four and five of the construction program at the bureau's new Gaithersburg site, the non-magnetic laboratory is now occupied my members of the staff of the N.B.S. Absolute Electrical Measurements Section.

In recent years, N.B.S. research that required a magnetically "clean" environment had suffered from growing interference at the bureau's old Washington (D.C.) site. The laboratory area intended for this work was originally built (in 1914) of materials having relatively low magnetic properties. However, the magnetic properties of the once clean area were seriously impaired by subsequent modifications to nearby space and by the accumulation in neighbouring laboratories of instrumentation and apparatus having iron and steel content. In addition, automobiles parked in nearby areas and moving on adjacent roadways produced intolerable magnetic disturbances. Because of its special construction, isolated location and commitment of the neighbouring ground, the new laboratory will provide a much better magnetic environment than was possible at the bureau's old Washington site.

Research in which small magnetic fields are to be precisely controlled must be performed where the earth's field is uniform and free from disturbances. This requires that the laboratory structure, its furnishings, and its surroundings be free from materials that can significantly distort the local magnetic field. Iron-bearing rocks or soil, steel hardware and tools, and even steel nails in the walls, floors, and ceilings must be avoided.

With the assistance of the Coast and Geodetic Survey, the laboratory planners surveying the Gaithersburg site found an out-of-the-way spot having a fairly uniform earth's field and not close (with one exception) to any sources of disturbing magnetic fields. This 600ft x 600ft site near an edge of the bureau grounds has a horizontal magnetic gradient of approximately three nanoteslas (three gammas) per meter, measured about 2 meters above ground level. This is about two orders of magnitude less than the gradient in recent years at the old laboratory in the District of Columbia.

The only source of magnetic disturbance at the new location is the enormous magnetic field from the bureau's linear accelerator, which is located about a quarter mile away from the non-magnetic area. Fortunately, the operation of this accelerator is not continuous and "quiet" times are available for critical work in the non-magnetic area.

Many of the items needed in conventional laboratories cannot be permitted in the non-magnetic laboratory. These include such commonplace things as air-conditioning machinery, typewriters, desk calculators, and even telephones. This difficulty was overcome by erecting two buildings, one a service building of conventional construction at the edge of the 600ft square, the other a wooden laboratory building from which ferromagnetic materials were carefully excluded.

The service building houses a conventional office with telephone service, instrumentation laboratories, electrical switches and circuit breakers, a battery room, and the heating and air-conditioning equipment for laboratory temperature control. From the service building a covered walkway runs 250ft to the non-magnetic building. Sheltered in the roof of the walkway are ducts for conditioned and return air, wiring for electrical power, and a cable tray for signal and instrumentation lines between the buildings. No other services are supplied to the non-magnetic building.

The minor magnetic anomalies found at ground level, resulting from iron-bearing soil and outcroppings of iron-bearing rock, forced a structural decision at the outset. Rock and soil near the non-magnetic building could be excavated and replaced with non-magnetic fill, or the work space could be elevated above ground level. The latter course was chosen as being less expensive; the vacant ground floor is useful as storage space for non-magnetic items and for experimental setups in which the magnetic requirements are not critical.

The floor above ground level contains an observation room and two laboratories equipped with limestone piers, which rise from their own foundations and are isolated from the structure of the building. During an experiment, the equipment mounted on these piers is manipulated from the observation room by means of rods passing through the wall. A single, large room above the piers will be used for experimentation with calculable inductors.

A small, wooden shelter set off from both the service building and the laboratory (out of range of disturbances from equipment in the service building and the experimental fields of the laboratory) houses a magnetometer. It will be used to sense the variations in the local magnetic field in order to control a correcting current for the Helmholtz coils located in the laboratory. This arrangement compensates for the continual small, natural variations in

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magnitude and direction of the earth's magnetic field, in order to provide stable fields in which experiments can be performed.

Obvious precautions against the presence of ferromagnetic materials in the non-magnetic laboratory were to specify the use of aluminium alloy nails, brass or bronze hardware, plastic air ducts, aluminium vents, plastic conduits, and porcelain lightbulb receptacles. Even the electrical power receptacles had to be specified to have phosphor-bronze backing springs for the plug jaws.

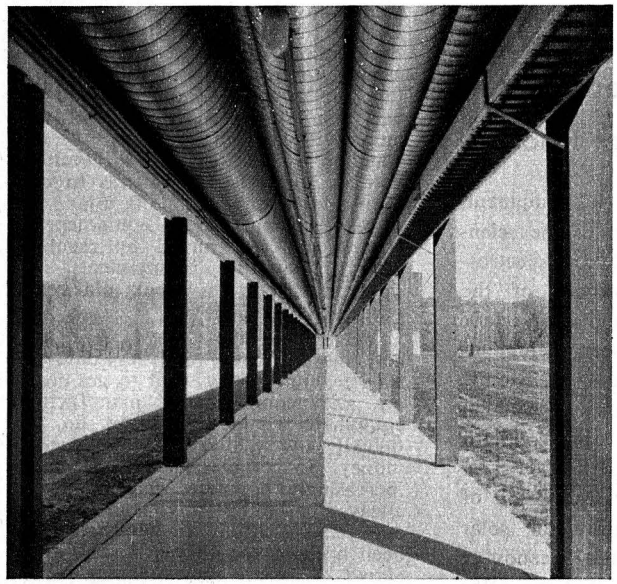
It was also necessary to monitor the construction regularly and to inspect materials before use. Despite all precautions of the contractor and his workmen, the monitoring procedure occasionally disclosed that some ferromagnetic item had been inadvertently incorporated in the structure; any such item was removed before construction proceeded. The concrete for the foundations, footings, and the walkway, 25 feet out from the building, was made of special cement, sand, and gravel that had been tested and found to be free from magnetic impurities.

A uniform magnetic environment is essential for absolute determinations of the ampere and the volt in terms of the basic mechanical units. In these measurements, the absolute ampere is first determined and then used with the absolute ohm to determine the absolute volt by application of Ohm's Law.

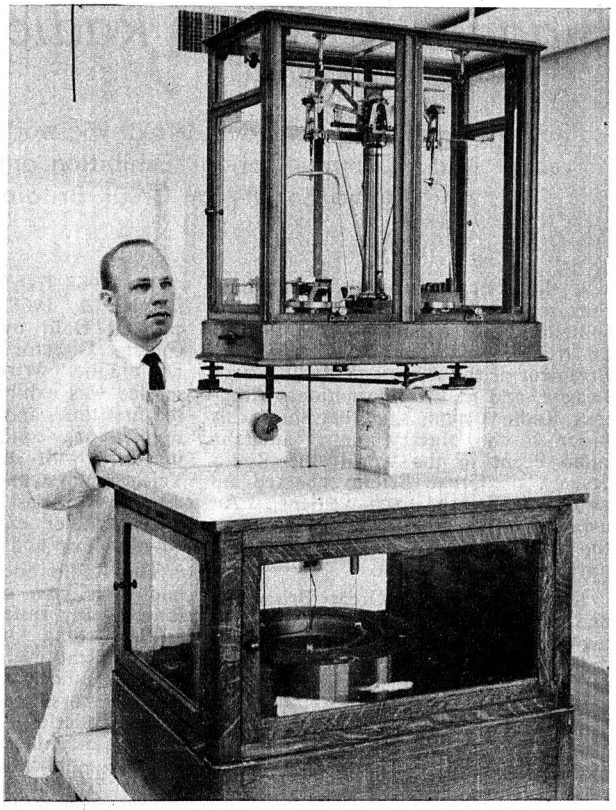
Many years ago, in conformity with international practice, the ohm was defined in terms of the resistance of a specified mercury column, and the ampere as the current that would deposit silver at a certain rate from a specified solution. But with advancing technology, it became apparent that these standards were not sufficiently reproducible. Now all three of the basic electrical units — ampere, ohm and volt — are defined in terms of the mechanical units of length, mass, and time — the meter, kilogram, and second.

These definitions are used in the difficult and time-consuming experiments required to realise the "absolute" units. The ohm is realised in terms of a calculable capacitor constructed to have a known reactance at a specified frequency. The ampere is determined in terms of the force between current-carrying coils. The volt, in turn, is realised as the product of the experimentally determined ohm and ampere.

Two types of ampere determination will be performed in the non-magnetic building. In one pier room, a horizontal solenoid is mounted on the pier structure and a smaller, vertical solenoid is supported on a fused silica balance frame inside it. When a current is sent through the dynamometer formed by the two series solenoids, the experimenter adds weights to balance the torque produced. Knowing the distance between the knife edges of the balance, the balancing mass, and the local acceleration of gravity, the experimenter can assign the value of the current in amperes. To determine the volt, the same current is sent through a known resistance; the voltage drop developed can be used to assign the value of the standard cells which maintain the reference unit of EMF.



The 250ft walkway between the service building and the new N.B.S. non-magnetic building carried under its roof the few services permitted to the latter — ducts for conditioned and returned air, power wiring and signal cables. The power wiring will be disconnected at the service building before sensitive measurements are made.



An N.B.S. scientist makes an adjustment to the current balance in the non-magnetic laboratory. The current flowing through the series connected coils of this standard can be computed with great certainty from its geometry and the change in the force between the coils when the connections to one coil are reversed.

The current balance in the other pier room consists of a stationary coil and a movable coil suspended coaxially within it from one arm of a balance. Here, also, the current through the series-connected coils can be calculated from the coil dimensions and geometry and from the force which the current creates on the movable coil. This force is known from the action of gravity on the masses required for the balance. The value of a steady current through the coils is most accurately determined by attaining a balance, reversing the relative polarities of the coils, and determining the change in mass necessary to obtain a balance again.

Another important experiment, one making use of the precession frequency of protons in a magnetic field, is performed occasionally to detect any change in the electrical units maintained by the bureau. A current established in terms of the N.B.S. volt and ohm is sent through a solenoid of stable dimensions to produce a magnetic field in which the proton precession frequency is measured.

It is critically important in this experiment that magnetic gradients in the observed volume be as small as possible and that the earth's magnetic field be compensated so that only the field of the current in the solenoid acts on the protons. If the precession frequency is found to be the same each time the experiment is repeated, then the units defining the solenoid current are known to be unchanged. This is because the measured frequency is dependent only on the magnetic field and on a fixed atomic constant — the proton gyromagnetic ratio. A change of less than 1ppm in the N.B.S. ampere can be detected in this way. ■

Biggest Amateur Radio Event in the World

Radio amateurs from many parts of the world attended the recent Radio Communications Exhibition organised by the Radio Society of Great Britain.

by Sylvia Margolis

If the Americans admit, unsolicited, that some other nation has produced something bigger than they can, it must be true! So, when Bob Denniston, President of the American Radio Relay League, and of the International Amateur Radio Union, said that this exhibition is the biggest annual amateur radio event in the world the Radio Society of Great Britain chalked up another British achievement. An average of 10,000 visitors click past the turnstiles each year during the four days of the exhibition.

Radio Society of Great Britain is one of the most active, forward-looking and receptive national amateur radio organisations, acknowledged and respected by official, professional and commercial agencies everywhere. Founded in 1913, R.S.G.B. is second in seniority only to the Wireless Institute of Australia. The society has a very high proportion of Britain's radio amateurs as its members, as well as an impressive overseas membership; its QSL Bureau is world famous; it publishes over 50 technical books; it is the only society of its kind to appoint a public relations officer and to operate a "Welcome Program" for overseas visitors; it is moving soon into elegant new premises and it enjoys a lively Royal patronage. (The Patron, H.R.H. Prince Philip, Duke of Edinburgh, maintains an active interest in the society's progress and he opened the 1966 Exhibition.)

The 1968 Exhibition was opened on October 2, 1968, at the New Horticultural Hall, by Mr W. J. Sharpe, C.B.E., Director of Communications, Diplomatic Wireless Service. This service was exhibiting at the show for the first time, and displayed radio communications equipment used in conjunction with the "Piccolo" Radio Telegraph system, as well as older gear used in the past on hand morse circuits. Other exhibitors included the Royal Navy and the Royal Signals.

The Radio Society of Great Britain had their own stand, said to be the longest ever installed at an exhibition — 100ft long. On sale were the society's publications and supplies and the society's officers were on duty to meet old members, greet new members and answer queries. A major attraction was the magnificent and enormous new R.S.G.B. publication, "Radio Communication Handbook," a completely rewritten edition, bang up-to-date, splendidly produced and weighing nearly 4½ pounds, yet selling for the modest sum of £3/3/. These were selling just as fast as the society's volunteer assistants could take the money!

Another interesting R.S.G.B. exhibit was the caravan operated by the Manchester Group of the Radio Amateur Emergency Network. The group bought, modified and equipped the 16ft caravan themselves and hauled it to London for the exhibition. Getting it up the flight of steps into the hall introduced all sorts of problems, not all of them concerned with communications techniques, and getting it down those steps after the exhibition was even more fun! A complete, mobile communications package deal, the Manchester caravan has seen real action twice already, once in a local air disaster and once when Manchester was flooded and police communications broke down. Normally, traffic handling by radio amateurs is forbidden, but a special G.P.O. concession allows the R.A.E.N. to handle traffic on behalf of the police, the Red Cross and the St. John Ambulance Brigade. This exhibit obtained national publicity during the exhibition when it was featured by a very popular B.B.C. early-morning magazine program called "Today."

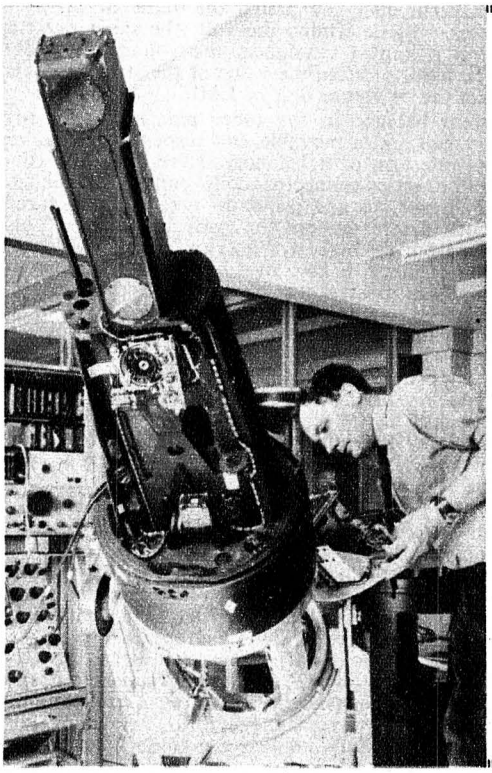
The Radio Amateur Invalid and Bedfast Club had an exhibit, too. With members all over the world, this is the radio amateurs' own charity and lots of good work is done by able-bodied members to help incapacitated members. Equipment is modified, special instruction and assistance arranged, gear is installed and maintained and the club's monthly publication, "Radial," keeps the members in touch. This little magazine, in itself, is a boon for the members, for loneliness is one of the worst facets of physical handicap. And, of course, amateur radio as a hobby gives home-bound people constant interest and companionship.

This is, of course, a commercial, as well as a cultural and social exhibition. Despite the increase in living costs and devaluation of the £ sterling, there seemed to be plenty of money changing hands over the counters. And here was manifested that fierce controversy among radio amateurs as to their function — **whether it is to communicate or to devise the means to communicate.** On the R.S.G.B. Stand was displayed some superb equipment designed and constructed by members. Stands handling components and government surplus stock did record business.

Yet people these days have more and more money, and less and less time to build. They want to get on the air and commercially manufactured equipment enables them to do that quickly and easily. All they need is money! So commercial gear is getting increasingly popular. Old timers are always bewailing this tendency, but one sensible radio amateur, who has been licensed for 43 years, said, at the Show: "Why are they moaning? When we first started we had to wind our own coils and make our own components. Now we buy them ready made. So what's so wrong with buying them assembled into equipment?"

American equipment is very expensive now in Britain, so few British

(Continued on page 174)



Solar Spectroscope for Skylark Rocket

Electronic equipment, which is part of the scientific payload for spectroscopic observations of the sun from stabilised Skylark rockets, is seen being installed at the U.K. Atomic Energy Authority's Culham Laboratory, in southern England. This system of spectroscopic observation of rockets stabilises the solar image to a few seconds of arc, in order that the solar corona can be examined in fine detail by the normal incidence spectroscope carried in the rocket.

NEW 8" CO-AXIAL SPEAKER WITH SEVEN POWERFUL MAGNETS AND UNIQUE NEW DESIGN—$34.50

The new CX-20D is the result of a revolution in speaker design combined with precision engineering. A horn type tweeter is used . . . a three inch voice coil . . . an electrical crossover . . . and weight is almost 8 lbs. Frequency response is substantially flat between 35-23,000 Hz. Cabinet specifications available **$34.50**

DEMAGNETISE YOUR TAPE HEADS AND IMPROVE TAPE PERFORMANCE!

Simply plug the tape head demagnetiser into any AC power point and pass over the heads. Takes only five seconds and can make a world of difference. Two models—single and double probe. Both . . . inc. sales tax **$3.90**

SOUND MODEL SAQ-505X — HIGH OUTPUT STEREO AMPLIFIER FOR ONLY $119.50

With an output of 25 watts R.M.S. in each channel into an 8 ohm speaker load, the 505X offers a frequency response of 20-20,000 Hz. plus or minus 1 dB. Sens. is 3 mV. All normal controls provided. Inc. sales tax **$119.50**

CONNOISSEUR STEREO CARTRIDGE — ONLY $10.80!

Designed to load any amplifier or tape recorder, the Model SCU-1 is regarded as the finest ceramic stereo cartridge ever produced. Ask for copies of reviews. **$10.80**

SHURE CARTRIDGES AT ATTRACTIVE ENCEL PRICES

All cartridges are brand new and Encel prices include sales tax. All Shure cartridges are fully guaranteed.

Model M44G—Retail $26—Encel **$17.50.**
Model M55E—Retail $49—Encel **$29.50.**
Model M75E—Retail $69—Encel **$42.50.**
Model V15E Mk. II—Retail $118.75—Encel **$74.50.**

Order now for prompt delivery by mail—or call at your nearest Encel Stereo Centre.

SAVE ON SANSUI!

All popular model Sansui tuner/amplifiers are now in stock and trade-in valuations are at an all-time high. Ask for your price!

CASSETTE RECORDERS

We cannot advertise Encel prices but write for an EMQ or call. Most popular brands available.

COMPLETE ENCEL STEREO SYSTEMS

Make your choice from the greatest range of equipment and cabinets when you select your new Encel Stereo System. Prices are the lowest in Australia.

MICRO DUST PICKUPS—$3.50

An effective automatic record cleaner which removes dust as the record plays. An ideal gift. $3.50 inc. sales tax.

ENCEL SERVICE DIVISIONS

Modern and efficient service centres operate in Sydney and Melbourne. Up to the minute servicing equipment is provided and skilled technicians who have been specially trained actually save you money when service is necessary as time expended is kept to a minimum. Encel service does not cost — it pays.

THE NEW ORTOFON S-15 AND SL-15 STEREO CARTRIDGES AVAILABLE AT ALL ENCEL STEREO CENTRES!

World wide acclaim provides significant testimony to the outstanding performance of the new Ortofon S-15 and SL-15 series. Ask for an EMQ or a trade-in valuation.

MICRO TONE ARMS OFFER OUTSTANDING VALUE!

Designed to track effortlessly with the most sensitive and delicate cartridges, Micro arms accept SME and ORTOFON head shells without modification. The Micro head shell accepts any standard ½" mounting cartridge. Vertical and horizontal movement is almost friction-free — tracking pressure is adjustable from 0.5 grams. Model MA88 (16") is priced at **$35.50.** Model MA77 (14") is only **$29.50.** Encel prices include sales tax.

RAPIER SOLID STATE TUNERS

A high quality AM tuner, the Rapier represents outstanding value. Output suits all amplifiers and tape recorders. The external teak finish case is optional. Price with case is $46.50 inc. sales tax. Encel price without case is only **$43.60**

TYPICAL TRADE-IN VALUATIONS ON A LUX SQ-1220

The maximum you will pay with your Leak "Stereo 30", Leak "Stereo 20" (with Varislope pre-amp.) or Fisher 101 will be $190. With your Quad Mk. II pre-amp. and power amplifier the amount will be a maximum of $120. And it could well be even less!

TYPICAL TRADE-IN VALUATIONS ON A LUX SQ-77TW

Changing up to a silicon transistor stereo amplifier can be quite economical; if you trade your Leak "Stereo 30", Leak "Stereo 20" (with Varislope pre-amp.), Fisher X100A or Pioneer SM83 your new amplifier will cost you a maximum of $30. With your Peak TRM-40 you will pay only $70, with your Star SA-30 the cost will be $120 and with your Linmark SA-200 the changeover will cost a maximum of $145. If your equipment is in excellent condition your payout can be substantially less!

LOW PRICED CERAMIC CARTRIDGE FOR BUDGET CONSCIOUS MUSIC LOVERS!

Now the well-known Micro Model SC301 Ceramic Stereo Cartridge with diamond stylus is available for only $6.90. Frequency response is 20-15,000 Hz. Tracking angle is 15°. This popular stereo cartridge is A1 value at (including Sales Tax) **$6.90**

HIGH FIDELITY STEREO 'PHONES COST LESS AT ENCEL ELECTRONICS!

Several wide range stereo headsets are now available including the new model Sonics HS-304. This headset is very comfortable and response is extremely good over the complete sound spectrum. Price is **$12.50;** a bargain basement cost for a headset of this calibre. From Sweden comes the Pearl 'phones . . . made by P.M.L. These 'phones are particularly sensitive and are high impedance (400 ohms). Fitted with ear muffs for long periods of fatigue-free listening. Pearl price **$19.50.** Sonics HS-304 **$12.50** including Sales Tax.

NEW HIGH QUALITY TONE ARM FROM ENCEL ELECTRONICS!

The new Nikka-Lustre Model ST510 is the successor to the well proven Model CP3. Thousands of these fine arms were sold all over Australia. Now the improved model at the old price is better value than ever. Model ST510 is priced at $19 inc. sales tax and the Model ST510D (with lifting/lowering device) is priced at only $24.50. Ask for full details. From **$19**

SAVE YOUR RECORDS . . . USE THE UNIVERSAL NIKKA-LUSTRE TONE ARM LIFT!

This beautifully finished and functional universal tone arm lift will fit all tone arms . . . the lowering action is pneumatically dampened and extremely smooth. Risk of record damage may now be eliminated. Including Sales Tax **$8.50**

NEW MODEL MICRO STEREO CARTRIDGE

The new Model 3100/5 and 3100/E (with elliptical stylus) stereo cartridges have now been released. An outstanding performer, the "3100 series" is also impressive by virtue of its low price. Ask for EMQ's.

WHARFEDALE SPEAKERS

See the complete range of famous Wharfedale speakers and speaker systems . . . ask for an EMQ or a trade-in valuation, as we are not permitted to advertise prices.

REPLACEMENT DIAMOND STYLII FOR MOST STEREO AND MONO CARTRIDGES

A replacement stylus for your cartridge can cost as little as **$2.50** when you buy from Encel Electronics. Correct replacements are available ex-stock for the majority of popular cartridges.

GRACE TONE ARMS . . . FOR THE PERFECTIONIST!

Two models of this sophisticated arm are available . . . the 12" G-540L and the 14" G-560L. A gimbal type gyroscopic bearing is used — and the Grace arm will track suitable cartridges down to ¼ gram with ease. A super light-weight head shell is supplied. Since this arm became available at Encel Stereo Centres many fastidious enthusiasts have traded much more expensive arms of Continental origin.

BIG VALUE COSMOS STEREO AMPLIFIERS

With an output of 8 watts R.M.S. or 15 watts IHFM in each channel the Cosmos SW-30C has a wide frequency response and is attractively priced at $79.50 inc. sales tax. Ideal for use with tape decks and sensitivity suits magnetic/crystal cartridges **$79.50**

FOUR LOW COST, HIGH PERFORMANCE SPEAKER SYSTEMS FROM ENCEL ELECTRONICS !

Separate speaker systems are essential if you wish to exploit the full potential of your amplifier, tape recorder or radio. Sonics speaker systems are beautifully finished in selected walnut/teak veneers, are styled to blend with period or modern decor and are extremely effective from an audio point of view. The following four models are the most popular.

MODEL AS-60E Slim Line 2 Speaker System — Although only 18 in. x 12 in. x 5¼ in. the AS-60E houses a bass/mid-range speaker and a high frequency reproducer. Impedance : 8 ohms **$27.50**

MODEL AS-61 5 Speaker Slim Line System — four bass/mid-range speakers and 2¼ in. tweeter unit are housed in this attractive teak/walnut enclosure. Impedance : 8 ohms. Measures 21¾ in. x 17¾ in. x 4¾ in. **$38.50**

MODEL AS-202 3 Speaker System — This dramatically effective 3 way system measures 20¼ in. x 11⅞ in. x 11⅜ in. and features an 8 in. bass speaker, a 6½ in. mid-range reproducer with a sealed back with a 2½ in. tweeter. Power handling capacity is 20 watts music power **$44.50**

MODEL AS-330. A 3-way speaker system with 5 speakers housed in a magnificent, hand finished, oiled teak enclosure. Frequency response is 30-20,000 Hz. Size: 15¾ in. x 11¾ in. x 26 in. Speaker complement includes a 12 in. bass reproducer, two 6½ in. mid-range speakers and two horn type tweeters **$98.50**

IMPORTANT: All Sonics enclosures have 8 ohm. impedances. Sales tax is included in all Encel prices.

STENTORIAN SPEAKERS NOW IN FULL SUPPLY!

Although supplies have not been readily available for some months, Encel Electronics now has stock of models 812, 816, 1012 and 1016. Ask for an EMQ or call at Encel Stereo Centres in Sydney and Melbourne. Save more on Stentorian!

SPECIAL OFFER . . . CROSSOVER NETWORKS — $4.90

Stentorian crossover networks feature crossover frequencies of 500, 1500 and 3000 Hz. For a limited period these units will be available for only $4.90 inc. sales tax.

SEE THE CELESTION RANGE!

Both models of the Celestion 12" co-axial loudspeakers (the CX-1512 at $44.50 and the CX-2012 at $64.50) are very popular with audio enthusiasts. If you're looking for a compact speaker system be sure to hear the Celestion "Ditton 10" ($59) and the "Ditton 15" ($89). All Encel prices include sales tax.

SAVE MORE ON ALL LEADING MAKES OF TAPE RECORDER

Encel Stereo Centres stock all the best makes . . . Akai, National, Toshiba, Philips, Revox, Randberg, Nivico and many more. You'll be wise to secure an Encel price before you commit yourself elsewhere. Save at Encel's!

NEW LIFT RELEASED BY GRACE — $11.50

This beautifully designed lifting/lowering device fits all types of tone arm. Action is velvet-smooth . . . and the lift is a fitting companion to the high quality precision Grace arms.

NEW GRACE CARTRIDGE!

With an output of 7mV, the superb new Grace stereo cartridge Model F-8M provides outstanding results. Frequency response is 5-35,000 Hz. Stylus pressures recommended are ¼ to 2½ grams. Ask for details!

NEW TONE ARM LIFT . . . THE COLTON "VARILIFT" . . . ONLY $7.50!

Fitted with a cranked lifting arm and push-button control the Colton "Varilift" is hydraulically dampened; operation is particularly smooth. Rate of descent is adjustable. Fits all tone arms. Ask for copies of review. Inc. sales tax **$7.50**

NEW SOUND MODEL SAQ-203 STEREO AMPLIFIER — $74.50

Frequency response is 30-20,000 Hz. and input sens. suits magnetic cartridges at 3 mV. Output is 12 watts R.M.S. or 30 watts E.I.A. peak power. 18 low noise transistors, headphone jack, all necessary controls. Inc. sales tax **$74.50**

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AIRBORNE WEATHER RADAR SPOTS THE STORM CENTRES

The nose cone of aircraft fitted with airborne weather radar has to be "radio transparent". In this Qantas Boeing 707, the nose cone is of honeycomb fibreglass material.

The menace of cumulo-nimbus clouds, and the storms which they enfold, has long been a major problem for those concerned with flying safety. Now the development of airborne weather radar permits aircraft crews to detect and avoid storms in the route ahead, thus contributing significantly to passenger comfort and safety.

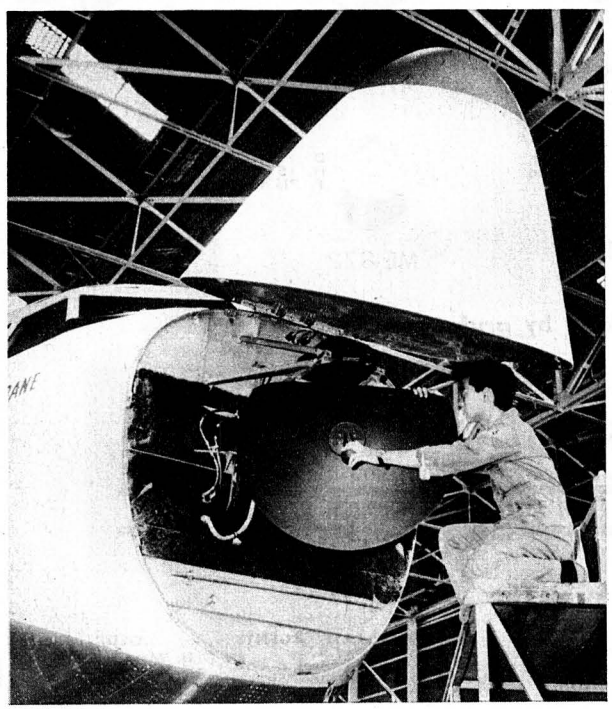
by William C. Moore *

With a meeting in Washington, D.C., the next day, a West Coast engineering representative boarded a Los Angeles-to-Chicago flight the night of April 30, 1952. His connecting flight was scheduled to arrive at Washington National Airport at 6.50 the next morning, adequate time to make the 9 a.m. conference. Near Omaha, a huge weather front welled up before the DC-6. The pilot could see only persistent flashes of lightning that occasionally illuminated monstrous thunderheads soaring to altitudes well above the operating limit of the aircraft.

With no more information about the storm-filled environment ahead than a horizon full of lightning and a weather report of extensive thunderstorm activity, the pilot had no choice but to avoid the weather front — a 400-mile detour.

Thus, the engineering representative did not make his connecting flight in Chicago for Washington. He got to the meeting — one of great importance to the airline industry and its passengers — about 2 p.m., when it was all over. The meeting, called by the airlines through the auspices of the Air Transport Association of America, was held to draft a set of operational requirements for a new tool to provide in-flight information about thunderstorms — airborne weather radar.

* *The author is on the staff of RCA Defence Electronics Products, West Los Angeles, U.S.A.*



The need for such a device had long been evident to the airline industry. The chances of survival for an aircraft caught inside those giant clouds known variously as cumulo-nimbus, thunderheads, or just plain thunderstorms are about like those of Russian roulette. Updrafts and downdrafts rip through the clouds at speeds as great as 150 miles an hour. Often, vortices of tornadic intensity reach like invisible tentacles from these storms. And on their leeward sides, hailstones of devastating size can pound out of shape an aircraft's control surfaces. Turbulence of sledgehammer ferocity can exert the equivalent of up to 10 times the gust-load design limit for transport aircraft, resulting in certain airframe failure. Wind speeds can be so great that, in one instance, a transport pilot, who inadvertently found himself climbing through a severe storm, suddenly saw his air speed drop to zero, completely cancelled out by a tremendous tail wind. Deprived of all lift, the plane dropped like a 300,000-pound lump of lead. Fortunately, the pilot was able to pull out of the dive and avert a crash.

The first time airborne radar was used to look at a thunderstorm has never been established, and probably never will be. It could have happened in this way. The pilot of a Navy F4F Hellcat, equipped with an AN/APS-6 general-purpose radar used for beacon navigation, ground mapping, and gun laying, is flying some dark night during World War II. He sees a large, bright echo on his radar screen with rounded characteristics and fuzzy edges. He knows that there is no land mass there to produce such an echo, nor any aircraft capable of it. In fact, its form is unlike any other solid target. Perhaps the next thing he sees is a lightning-illuminated black mountain of cloud, soaring as high as 60,000 feet.

Occurrences similar to the above happened many times during World War II. Thus, before war's end, pilots began using their general-purpose radars for weather avoidance, even though this equipment was never designed for such an application. Later, these pilots, transplanted to the cockpits of postwar airliners, told of this ability of airborne radar to detect storms, and the airlines began taking steps to develop similar electronic devices for their planes.

Among the pioneering airlines in weather radar research were Trans World Airlines and American Airlines. From late 1945 and into 1946, TWA conducted tests with a make-shift radar put together from military war-surplus equipment. The somewhat negative results of the project

A Qantas technician servicing the scanner of a Boeing 707's weather radar. The scanner is mechanically operated to sweep the flight path ahead of the aircraft.

Maya

Combination Type Moulded Knob Series

D—Lower diameter. H—Height. F—Finish.

D. 11/16"
H. 7/8"
F. Plain

ME-829

D. 9/16"
H. 13/16"
F. Plain

ME-830

D. 15/16"
H. 1-3/16"
F. Knurl

ME-833

D. 11/16"
H. 1"
F. Knurl

D. 11/16"
H. 13/16"
F. Plain

ME-834 ME-835

D. ¾"
H. 9/16"
F. Plain

ME-836

D. 13/16"
H. 9/16"
F. Knurl

ME-837

D. 1"
H. 11/16"
F. Knurl

ME-838

D. 13/16"
H. 5/8"
F. Knurl

D. 9/16"
H. 13/16"
F. Plain

ME-839 ME-840

D. 1"
H. 7/8"
F. Knurl

ME-844

D. 15/16"
H. 1¼"
F. Knurl

ME-846

D. 11/16"
H. 1-1/16"
F. Knurl

ME-847

D. 11/16"
H. 1-1/8"
F. Plain

D. ¾"
H. 7/8"
F. Knurl

ME-848 ME-849

D. ¾"
H. ¾"
F. Knurl

ME-850

D. 11/16"
H. 15/16"
F. Plain

ME-851

D. 11/16"
H. 1-1/16"
F. Knurl and Plain

ME-852

D. 9/16"
H. 1"
F. Plain

D. 9/16"
H. 15/16"
F. Plain

ME-854 ME-855

D. 9/16"
H. 15/16"
F. Plain

ME-856

D. 9/16"
H. 13/16"
F. Plain and Knurl

ME-857

D. 9/16"
H. 15/16"
F. Plain and Knurl

ME-858

D. ¾"
H. 11/16"
F. Plain

D. ¾"
H. 13/16"
F. Knurl

ME-859 ME-863

D. 1"
H. 15/16"
F. Knurl

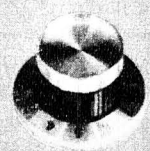
ME-864

D. 1"
H. 13/16"
F. Knurl and Dot

ME-865

D. 1¼"
H. ¾"
F. Knurl and Dot

ME-866



D. 1-7/16"
H. 7/8"
F. 0-10 on metal

D. 1-7/16"
H. 7/8"
F. Arrow

ME-867

ME-868

As 867 and 868
Bakelite skirt

ME-869

ME-870

D. 11/16"
H. 13/16"
F. Knurl

ME-871

D. 11/16"
H. 15/16"
F. Plain

D. 9/16"
H. 1"
F. Knurl

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sent no one scurrying to build a radar around the TWA set. But the tests did inspire enthusiasm in TWA about the possibilities of such a system, and the result was a recommendation that airborne weather radar be developed specifically for storm avoidance by transport aircraft.

Then, for six months during the 1947-1948 period, American Airlines, working with the U.S. Navy, proved out the practical airborne application of a technique called "iso-echo contour." Developed during World War II by meteorologists using ground-based radar, the technique is used to identify the most dangerous part of a storm. Weather radar keeps planes out of turbulence because those areas within a storm with the most intense rainfall are associated with the most severe turbulence, and the radar gets its strongest signal from the heaviest rainfall. With the iso-echo contour — or simply "contour" — system, the strongest echoes, signifying the most hazardous part of the storm, are blanked out. This relieves the pilot of the task of determining the difference between bright and brighter on his radar scope — a problem that would be similar to reading a newspaper printed in ink a little whiter than the paper. What the pilot sees when using the contour circuitry in his radar, then, is a bright area, indicating rainfall of significant intensity, and a black hole in the middle of the bright area, indicating very heavy rain and, therefore, heavy turbulence. He scrupulously avoids the black holes.

These early tests of radar for weather avoidance by TWA, American, and others, including the Naval Air Test Centre at Patuxent River, Maryland, convinced almost everyone that transport aircraft must have this radar. However, there were formidable problems to deal with before the dream of an airline fleet completely equipped with weather radar could become a reality. First of all radar used in these experiements had been modified versions of military equipment. As such, it was too heavy—200 to 300 pounds per unit—and far too complex for the weather mission. In addition, it broke down frequently and was difficult to maintain. Another major problem was that all of the radars used in the weather experiments operated on X-Band frequencies around 9000MHz. Many of the men involved in developing airline weather radar had serious doubts that X-Band was the best frequency.

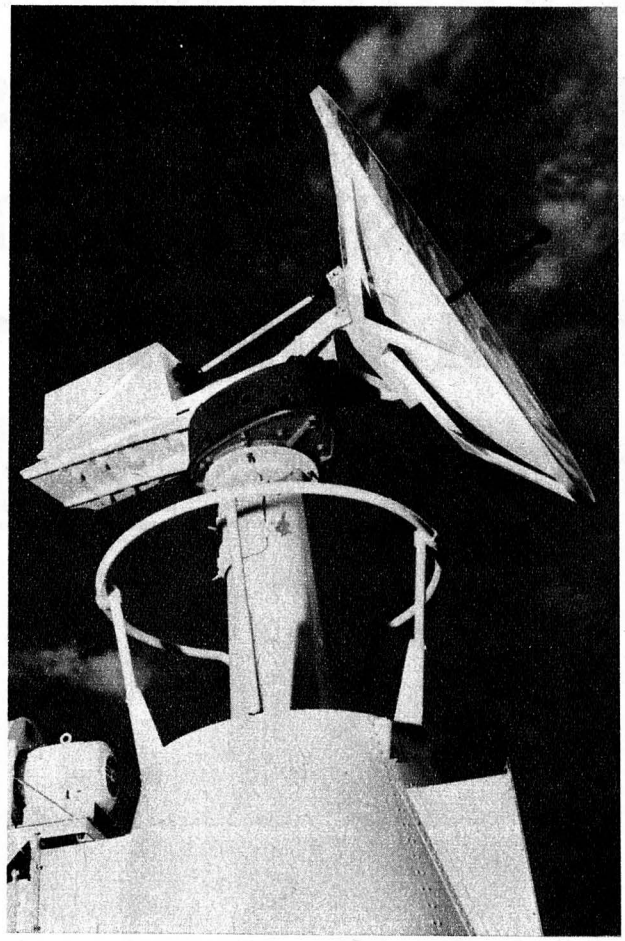
The phenomenon that was bothering these people is the tendency of electromagnetic radiation, as its frequency increases, to act more and more like visible light. With frequencies in the thousands of MHz, the signals are absorbed and scattered by smaller and smaller particles — such as rain—just as light is absorbed and scattered by the fine mist of a cloud or fog. The experimenters began to realise that X-Band frequencies were being stopped by moderate to heavy local rain, preventing the radar from showing more distant storms behind the rain. This fact led the Navy's Patuxent River centre, after testing contour circuitry on an AN/APS-33 radar, to conclude in May of 1951: "The iso-echo-contour attachment will be of little value, however, when employed in conjunction with present X-Band radars as an aid to select least turbulent traverses once an aircraft has entered a storm. This fact is due to severe propagation attenuation (scattering and absorption) in heavy precipitation at X-Band frequencies, which results in shortened radar ranges and false contour separation displays."

But by this time airline traffic was increasing rapidly. Already there were known turbulence-caused crashes, and many more were suspected. Something had to be done, and the May 1, 1952, meeting in Washington was called through the auspices of the Air Transport Association of America.

The Association drew up a list of 10 operational requirements for an airline weather radar. These were turned over to Aeronautical Radio, Inc. (ARINC), an organisation established by the airlines. ARINC's job: turn the 10 requirements into electronic equipment characteristics.

The toughest of these requirements was the one dealing with attenuation. ATA specified that: "The equipment must be capable of penetrating and displaying at short range rainfall rates of 60mm per hour to a depth of 15 miles." In other words, the radar had to penetrate for 15 miles rain failing at a rate of 2-3/8 inches per hour—a veritable deluge. The feeling was that this requirement ruled out X-Band. To make doubly certain, ARINC turned to scientists at McGill University, Montreal, where extensive meteorological research had been conducted, to recommend a frequency for airline weather radar. In a report dated February, 1953, McGill said about X-Band: "It is not just a matter of the range being limited. There is also the uncertainty

"RAINBOW" STORM-WARNING RADAR



High power, long range, ease of installation and relatively low cost are four of the main features claimed for "RAINBOW"—a new meterological radar system developed in the U.K. by The Marconi Company. The makers say the system is accurate and reliable, and can track and pinpoint storms and rain-producing clouds within an area of 125,000 square miles. RAINBOW has been designed to provide an inexpensive equipment suitable for use at airports, where it can provide first-hand meterological information to the air traffic control centre.

of whether one sees light rain through a small amount of intervening precipitation, or heavy target rain through much intervening precipitation."

McGill's conclusion was that a C-Band frequency approximately one-half that of X-Band, about 5400MHz ". . . would provide optimum performance for weather mapping radar from the standpoint of providing maximum sensitivity with minimum attenuation of signal in heavy rain."

The ink was hardly dry on the McGill report when United Air Lines, in association with RCA, began a program that was to become the most extensive test of weather radar to date: a test to determine whether the mathematical conclusions of the McGill scientists were valid in the wild and woolly summer skies of America's Midwest.

In February, 1953, RCA's aircraft electronics centre in Los Angeles undertook the job of building the world's first airborne C-Band weather radar. The schedule: have the new radar installed and operating in a DC-3 by June 1, in time for the thunderstorm season in the Denver-Omaha area.

The assignment was a tough one. In going to C-Band, all radio frequency components had to be changed, and these components were not readily available because airborne radar up to that time was largely X-band. A new magnetron had to be found, a new antenna had to be designed, and the radar had to contain the iso-echo contour

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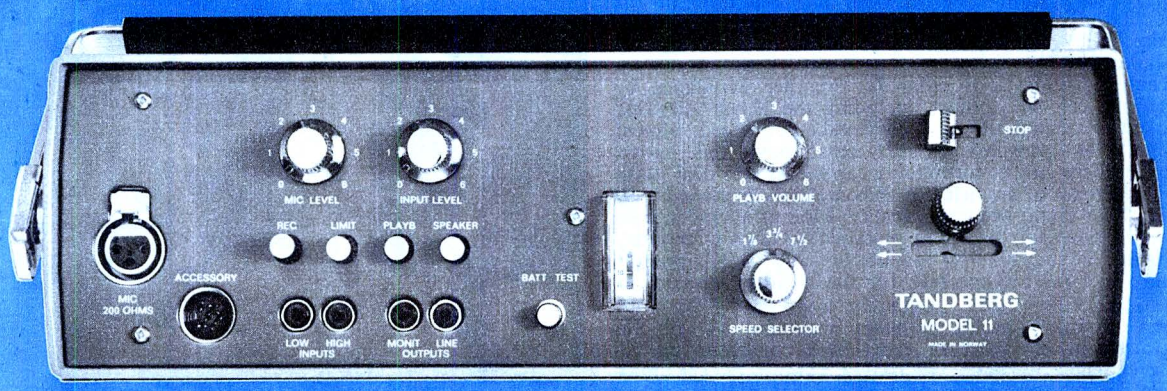

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circuitry developed by American Airlines. But delay could mean lives, and the RCA team went to work. On May 27, 1953, United Air Lines DC-3 N-17890 landed at Los Angeles International Airport with an empty radome nose cone installed by Douglas Aircraft Company. On May 29, it took off for Denver equipped with an experimental C-Band weather radar, and project "Sir Echo" was under way.

United flew N-17890 around, near, and through thunderstorms in the Denver area until October 16, 1953. Forty flights were made, totalling 133 hours in all. Of this time, 80 hours were spent in the immediate vicinity of or inside thunderstorms. The DC-3 was manned by United and RCA engineers, and recording equipment installed in the plane took more than 6,000 pictures of the radar display. In order to determine the density of rainfall through which the radar was seeing, the pictures were correlated to rain-gauge readings from the ground, and at one time N-17890 flew into a squall line in formation with a Navy R5D (military DC-4) equipped with X-Band radar for comparison purposes.

Almost all the results were positive. The radar easily penetrated 15 miles through rain falling at the rate of 2 3/8 inches per hour. Extensive storm fronts were safely negotiated with a delay of only minutes. The flight crew found it easy to distinguish between the rounded, fuzzy appearance of storm areas and the concentric arc characteristics of ground clutter. And, as an unexpected bonus, the team was able to correlate fingers and hooked fingers extending from weather echoes on the radar screen with hail, a relationship later substantiated in tests by Braniff International Airways. All of United's questions were answered. With small deviations in flight-plan route, C-Band radar does permit detouring away from moderate to heavy turbulence and damaging hail. C-Band radar does see through enough heavy rain so that a pilot will not be led blindly into the hard core of a storm. The only negative aspect was that the presence of tornadoes could not be deduced from anything presented on the radar screen.

By the time the airlines had completed their specifications for weather radar, RCA and other manufacturers were already designing production radars. Some airlines, placing emphasis on storm avoidance rather than penetration because of the nature of weather along their routes, chose X-Band designs. RCA's AVC-10 C-Band radar, today the most common airline radar in existence, was ready for production in 1954, and early the following year the first production prototype was delivered to United Air Lines for evaluation. Soon, radar-equipped aircraft, with their characteristic black noses, began appearing at the nation's airports. A few years later, the Federal Aviation Agency made this equipment mandatory for airliners.

But this did not complete the job. Business flying was on the increase, and the small business planes were flying in much the same environment as the airlines. On-time schedules were just as important to the business executives as to the airline passenger, and their planes gradually became almost as well equipped as transport aircraft. However, their radar requirements were slightly different. These craft were too small to venture too close to storms, and the large, relatively heavy C-Band radar was too cumbersome for them. So, radar manufacturers turned to X-Band, with its lighter components, smaller antennas, and narrower, more concentrated beam, in order to develop radar suitable for guiding these aircraft around the storm cells. By 1962, RCA was delivering the AVQ-20, a 47-pound, 180-mile-range X-Band radar, to this mushrooming fleet of business and executive aircraft.

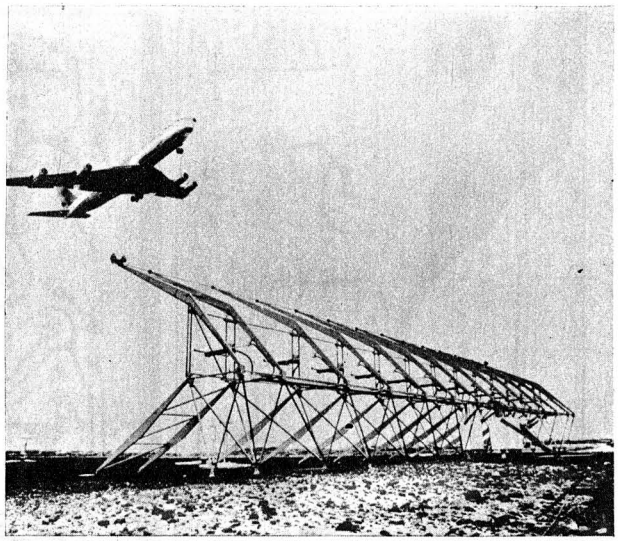
Today, only 12 years after the airlines received their first production radar, this equipment is available for any plane with a place to put it. One newly developed X-Band radar, for example, can provide the lightest twin-engine plane with 80 miles of warnings about storms in its path.

For the future, a team of RCA engineers at the Los Angeles facility is putting the final touches on the design of a new generation of radar for a new age of air transportation, the era of the giant 300 to 500-passenger aircraft and the supersonic transports. Designated the AVQ-30, this radar, produced in either C or X-Band models, will have even longer range — 300 nautical miles — and many other new features. But most importantly, it will show a marked improvement in reliability, a feature made necessary by the unprecedented cost incurred when one of these high-capacity aircraft has to sit on an airport ramp because of equipment failure. A single system AVQ-30 will have a mean time between failure of over 1,000 hours, more than twice that of existing radars.

When it is installed in a dual system as recommended by the new airline radar specifications, reliability soars. In these circumstances, when an aircraft is used **about** 10 hours a day, and all radar and associated equipment are operating properly at the beginning of each day, the average aircraft will operate for 18,000 hours or 1,800 days without a total radar system failure. This is a 36-to-1 improvement over today's equipment.

The battle against turbulence does not end with the perfection of microwave radar. Another weather phenomenon, as stealthy as its name implies — "CAT" for Clear Air Turbulence — remains to be conquered. Many companies and government agencies are working toward devices for detecting this invisible turbulence that is completely unassociated with clouds or rain, yet on rare occasions is so violent that it has dropped jet liners with such force that engines have been torn loose. The Federal Aviation Administration has tested a promising device that uses an infrared spectrometer to tell the differences in temperature between clear air masses causing the turbulence. But to date, no foolproof solution has been found, and CAT still challenges the ingenuity of the aircraft electronics industry. That challenge will be met, and the day will soon come when another step will have been taken in the continuing effort to make air travel the safest, most comfortable, most reliable way of getting around.

(Reprinted from RCA's "Electronic Age.") ◘



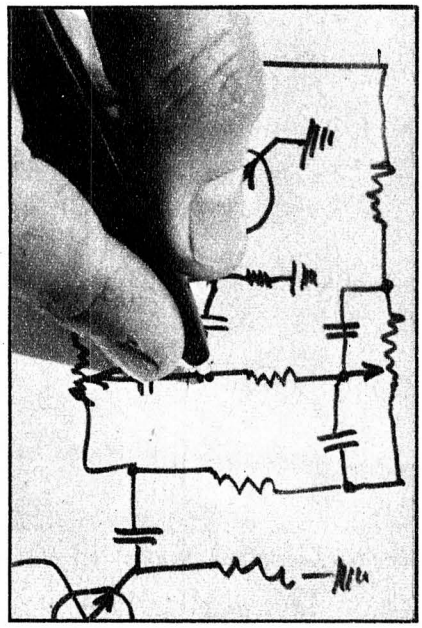
The I.L.S. localiser aerial at Sydney Airport.

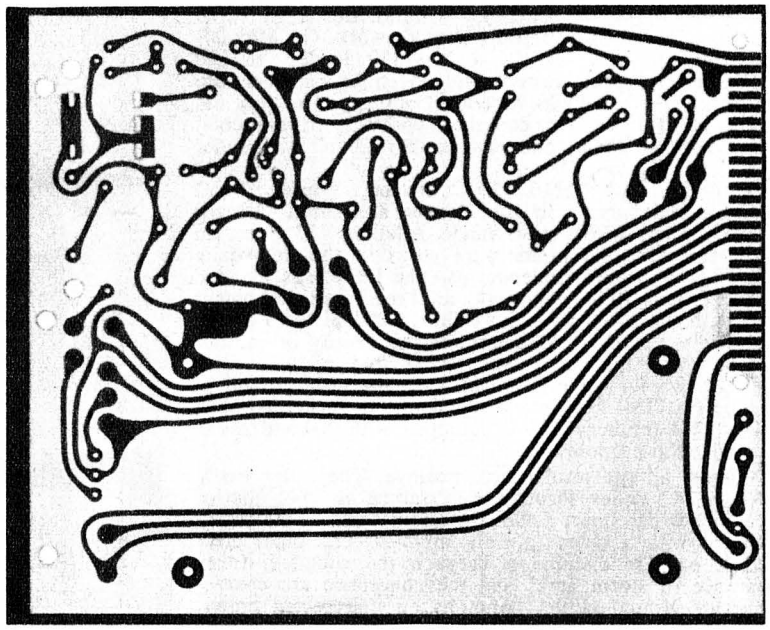
I.L.S. Installed at Sydney Airport

The Instrument Landing System ordered by the Department of Civil Aviation for Sydney's Kingsford Smith Airport has been installed for use with the new north-south runway. A similar system is currently being installed for the Tullamarine Airport, Melbourne. The equipment in both cases has been supplied by Standard Telephones and Cables Pty. Ltd., on behalf of S.T.C. in the U.K.

The function of the Instrument Landing System (I.L.S.) is to enable pilots to make a safe approach and landing in conditions of bad weather and poor visibility. In England, planes are regularly landed completely automatically by I.L.S. systems.

The initial order received by S.T.C. from the Department of Civil Aviation is for five localisers and three glide paths. All electronic equipment is transistorised, and fully duplicated for complete reliability. To ensure immediate availability of the standby unit should the duty transmitter fail, the standby works into a dummy load while the duty transmitter operates into the aerial. Transmitted signals are continuously monitored so that any fault conditions which arise can be detected immediately. (For a description of the S.T.C. Instrument Landing System, see "Electronics Australia" January, 1967, page 21.)





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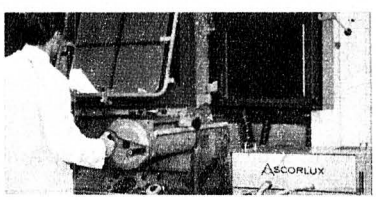

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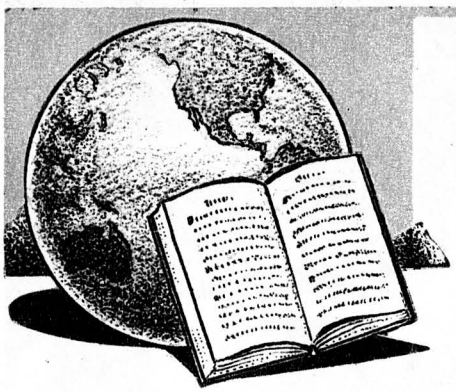


Technical Review

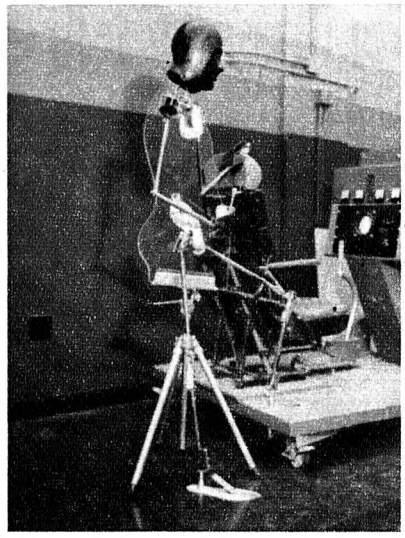
ROBOT AIDS COCKPIT DESIGN STUDIES

While the science of robotics has in general moved away from the concept of humanoid forms, and has tended to think in terms of metal boxes on wheels, fitted with mechnical pincers, there is still a place for a man-shaped robot in some instances, as this story from the August, 1968, issue of "Boeing Magazine" proves.

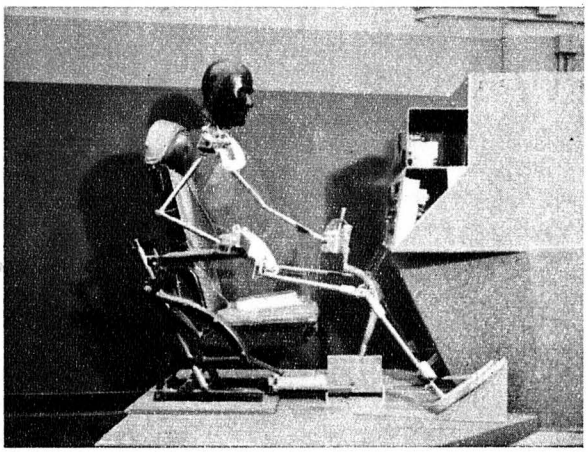
There's a new man on the staff of Boeing's Military Aircraft Development Systems Support Group. He is really a Navy man and he's still learning his job, but in about six years, he'll probably be one of the company's most valued test pilots. His name is Boeman and he is a robot—not a mechanical man but rather a mathematical model programmed for a computer.

Boeman isn't Boeing's first robot "test pilot" but he may turn out to be the company's most unusual one. Born in January, 1968, of Contract N00014-68-C-0289 from the Office of Naval Research, Boeman now is a collection of computer descriptions of lines and pin-points. By 1973, however, he will be a fully clothed, three-dimensional elastic man-model. Boeman is even expected to have "deformable" skin which is an engineer's way of saying you will be able to see his skin ripple when he flexes his muscles.

The robot's job will be to see if the drawing-board designs of cockpits for projected aircraft actually will be acceptable to pilots. If an important switch is placed above and behind a pilot's head, for example, Boeman can determine whether a given-sized pilot can reach and operate the switch.



While his limbs are only skeletal frameworks at present, Boeman is still plainly humanoid in form.



Boeman in the pilot's seat of a simulated aircraft cockpit. His main function is to test the feasibility of drawing board cockpit designs.

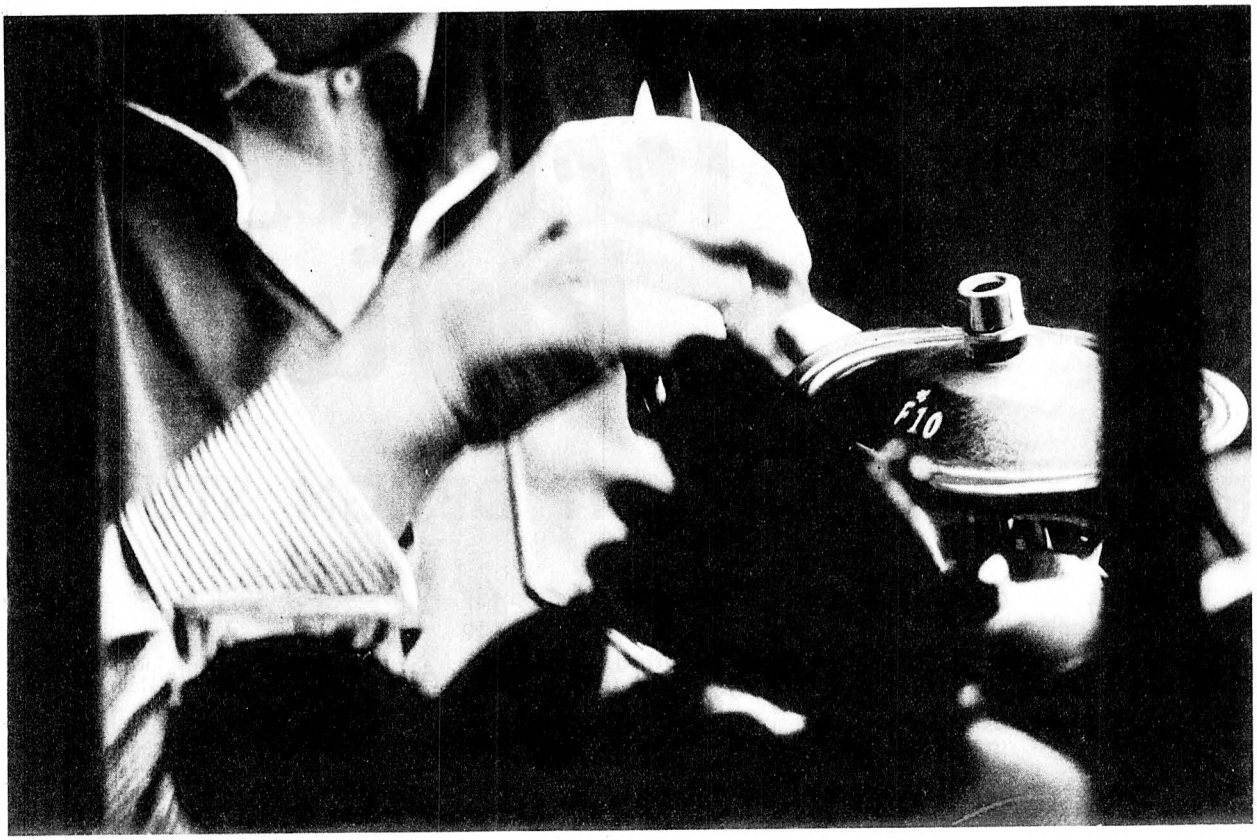
Live pilot subjects were out of the running for Boeman's job long before he was even conceived. Human anthropometric data is hard to handle because of its massive quantity. It is very difficult to place useful instruments on a human being to measure exact values without interfering with the test itself. Besides, the aircraft to be tested will be just paper dreams, not hardware. Even Boeman will have to keep in touch with a complex series of computer instructions to be sure of exactly what sort of aircraft he's flying.

The development of a computer program for the robot will be one of the main features of the initial work. Film sequences of pilots using a new Boeing multi-mission flight simulator will keep the computer program accurate and will be the basis of verifying final computerised activity for Boeman.

Once fully developed, Boeman's programming will pit human limitations against cockpit geometry, mission requirements, on-the-spot occurrences, visual interferences and physical problems. Tests will include how much work the pilot can be expected to do under certain conditions and, possibly, even how much psychological stress might help or hinder the cockpit situation. Computer programming will allow the robot to "change size," although this will not be a physical change. The computer simply will interpret Boeman's reactions according to the size of the man he's supposed to be at the time. The computer will also change the size of the cockpit around Boeman as the engineers dictate.

To make Boeman into a flight-test Pinocchio, Boeing engineers and the Navy will have to dig up new facts on how digits fit together, the movement of joints, how much force a man's arm, hand and leg can produce, and how skin interacts with arm and leg movements. University, military and industrial laboratories will aid in developing details on how best to get the robot's backbone connected to the thigh bone, etc.

Right now, Boeman is being engineered for 23 movable joints. This won't allow him to play tennis or frug, but after all, everybody's got to start somewhere. ■



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NEW GLASSWARE IMPROVES CHROMATOGRAPHY ANALYSIS

New hardware developed to further the science of chromatography include special porous glassware and a complete analysing unit with electronic control facilities.

Ernie Miller thought he had it made. The dilemma of trying to support two wives and keep pace with his mounting debts so disturbed Ernie that one night he picked up a hitchhiker, drove to a lonely country road, choked the unfortunate rider into insensibility, saturated his clothes with petrol and set the car on fire. At first, everyone thought the nearly destroyed corpse in the driver's seat was Ernie. Only an uncharred, postage-stamp-size scrap of the victim's trousers suggested a more sinister motive. The miniscule piece of debris was all the crime laboratory needed to prove the man's clothes had been soaked with petrol before the blaze and to start the search which ultimately led to Ernie's arrest and conviction.

Ernie Miller, is a fictitious name, but the incident is real. The behind-the-scenes detective that solved the case was an analytical gas chromatograph, an electronic instrument that's part of the much broader field of chromatography used by organic chemistry and biology laboratories for separating liquid or gaseous mixtures and identifying their individual components. That scientists can work with incredibly small samples frequently no larger than the dot of a "i" is one reason chromatography today is regarded as one of the most accurate and fastest growing scientific sleuthing devices going.

(Although the term chromatography implies that colour is a necessary part of the detection process, the methods can actually be applied to coloured or uncoloured compounds alike).

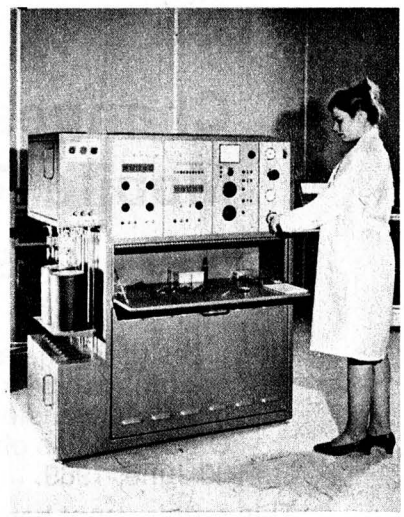
So broadly adaptable is chromatography that it is used by more than 50,000 laboratories which spent over $US75 million last year for all types of chromatography equipment. The applications include everything from manufacturing medicines through food processing controls to determining the presence of narcotics in human blood.

How does a chromatographic separation work? "It's a matter of attraction," muses one chemist, "that is much like the affinity three men have for blondes. For example, when they pass a blonde girl on the street, one man may stop and look at her, the second may slow down and look, while the third just keeps on going."

The attractions in a paper chromatography process, for instance, begin when a drop of an unknown mixture is placed near the end of a strip of filter paper then immersed in a solvent. As the solvent migrates up the paper, each of the mixture's components is influenced by two opposing forces: its tendency to be washed up the strip with the solvent and its affinity to bond itself to the paper. The individual components separate and the colours, intensities and locations of their deposits can be compared with the separations of known materials to characterise the unknown mixture.

In addition to paper chromatography there are three other basic categories of chromatography: (1) Thin layer, in which the sample mixture rises and separates by capillary action on a glass plate coated with a powder-like material; (2) liquid or column chromatography in which gravity or pressure forces the sample mixture and solvent to flow through a glass column packed with the separation medium; and (3) gas chromatography in which the sample mixture is vapourised and moved by an inert gas through a heated column packed with an absorbent material.

As might be expected, one principal beneficiary of chromatography is the pharmaceutical industry which uses a variety of techniques in the preparation of drugs and medicines. In addition, chromatography is used for identifying lipstick or shoe polish smudges in criminal investigations; detecting the presence of barbiturates in the blood stream; for quality control in the preparation of such things as perfumes, paints, dyes, cosmetics and tobaccos; detecting impurities in oils and greases in refineries; and for untold numbers of organic chemistry and biomedical research applications; toxicology examinations, pesticide controls, and air and water pollution studies to name a few.



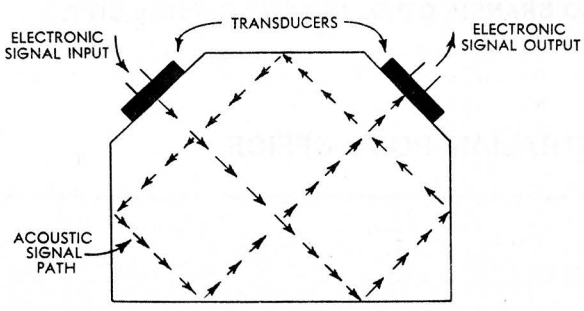
Corning Glassware's Type APG 402 gas chromatography unit is all automatic and electronically controlled.

Surprisingly, chromatography is not a new science. In 1903, Russian botanist M. S. Tswett developed an ad-

HOW A GLASS MEMORY OPERATES

In our November, 1967 issue, we published a description of the B.B.C. standards conversion equipment which allows programs generated in America, using the N.T.S.C. 525-line, 60-field system, to be electronically converted to the B.B.C. 625-line, 50-field PAL system. In the article, we referred to the important role played by delay lines. We are now advised by Corning Glass Works that they supplied glass delay lines for the equipment, and that these operate in the following manner.

The delay line acts as a memory which stores information by converting electronic signals to acoustic signals, passing them through glass polygons and then restoring them to electronic form (see diagram). As the acoustic pulses move at the relatively slow speed of sound, compared with the high speed of electronic pulses, the signals are delayed.



Electronic signals are converted to acoustic signals at the input, then travel the path shown by the arrows to the output transducer which reconverts the signals to the electronic form.

Changes for Mobile Radiotelephone Services

Licensees of V.H.F. land and harbour mobile radiotelephone services, now operating in 30 kc/s channelling areas, are advised that if they have not already installed equipment which meets the Australian Post Office 30 kc/s channelling specification, they must do so before 30 June, 1969.

This requirement has been brought about by the growing demand for V.H.F. mobile radiotelephone services in city areas which is taxing the existing channels available. The change to 30 kc/s channelling will enable more radiotelephone services to be brought into operation as they are required.

However, some changes to existing equipment will be necessary and the following programme for conversion, which is designed to cause the least inconvenience to all concerned, has been adopted:—

As from 30 June, 1969, licensees of V.H.F. mobile radiotelephone services operating in 30 kc/s channelling areas within the frequency bands 70-85 Mc/s and 156-174 Mc/s* will be required to make necessary changes so that:—

(i) All base station transmitter/receivers (both amplitude and angle modulated) employed in a base station installation shall be of a type complying with the relative Post Office specification and approved for 30 kc/s operation and shall be operated in accordance with the terms of that specification.

(ii) All angle modulated mobile transmitters shall be adjusted to function with a maximum deviation of ±5 kc/s.

*This excludes the International Maritime Mobile V.H.F. Radiotelephone and the existing Australian Post Office Subscriber Services.

Early conversion will assist manufacturers in meeting delivery dates for equipment.

FURTHER DETAILS MAY BE OBTAINED FROM THE SUPERINTENDENT, RADIO BRANCH, G.P.O., IN YOUR CAPITAL CITY.

AUSTRALIAN POST OFFICE

sorption chemistry technique and published his findings on separating the pigments in leaves. However, it wasn't until the early 1950s that scientists began making wide use of chromatography techniques for both qualitative and quantitative analytical work. About the same time, a search was under way to find a technique for characterising fountain pen inks.

"Inks are important factors in suspected forgery cases," explains one criminalist (i.e., one who preoccupies himself with physical evidence rather than criminal motives). "For example, if a forger alters a $6 check to read as $60, it's probable that he will use an ink that looks the same as the one the originator used. The difference, though, is clearly seen when samples from, say, the "6" and the "0" produce different chromatographic separations. In fact, in some instances it may even be possible to determine the precise brand of ink the forger used."

Still, the early chromatographic separations were far from ideal. Paper chromatograms provided accurate visual data, to be sure. But when a laboratory technician used a densitometer to measure the light transmitted by a beam going through a deposit and transform the visual data into numerical values, the opaque quality of the conventional paper chromatogram restricted the transmission of light. One need, therefore, was for a transparent chromatography medium on which optical measurements could be made.

Porous glass from Corning Glass Works proved to be a suitable material. This is an intermediate product created during the production of nonporous laboratory glassware. Twenty-eight per cent of porous glass's surface is void space composed of an infinitesimal number of tiny pores which would would have to be enlarged 12,000 times to admit a human hair. The remaining surface area adsorbs moisture and organic chemicals while the components in a chromatographic separation dry rapidly in a small, confined area.

Porous glass plates proved to be satisfactory and versatile chromatographic mediums but they were only the beginning as far as Corning's researchers were concerned. They continued to search for ways to take the guesswork out of the laboratory and come up with chromatography materials that would ultimately satisfy the scientists' every need.

One example: Surface-textured glass beads which have a surface area 10 times greater than the conventional smooth beads that were previously used as the support material in gas chromatography.

Today Corning's products include glass plates which are precoated with porous glass adsorbent for thin-layer chromatography which relieves laboratory technicians of preparing their own; Pyrex brand glass columns with metering valves for controlling the flow of solvents during column chromatography separations; and a variety of rectangular and cylindrical "jars" used as development chambers in thin-layer processes.

One of the newest of Corning's chromatography products is glass particles with precisely controlled pore diameters. Because fractions are separated by the size of the molecules as the sample flows downward through the particulate material in a liquid chromatography process, the uniformity of the microscopically tiny pores — which can be controlled within tolerances of 15 per cent — assures more precise separations.

By contrast, Corning's biggest chromatography product is an automatic, highly reliable preparative gas chromatograph, called APG 402. A sample is introduced into the APG 402 either automatically from a side-mounted reservoir or manually from a syringe. The sample vaporises and flows through a series of columns where it is separated into its individual fractions for collection, examination and identification.

While glass has already made deep penetrations in all categories of chromatography, Corning's researchers say they have just begun to exploit the potential of this versatile and complex science. Thin-layer chromatography, they point out, has supplemented or replaced paper chromatography in many laboratories. In addition, scientists are looking for ways to improve their techniques and are finding that chromatography enables them to do more work more accurately, in less time than before, and to work with samples which once might have been discarded for being too small, too difficult or simply impossible to separate.

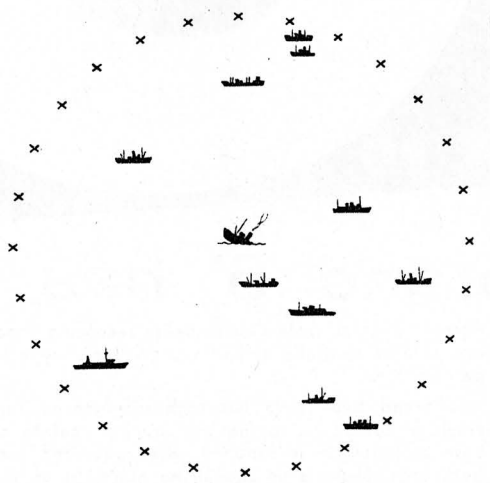
"Chromatography is now a principal means for acquiring evidence or information which might otherwise go undetected," says one chemist. "Why, it's even possible today to extract some juice from a carrot and tell which part of the country it was grown in." ("Corning Magazine," Summer, 1968.)

AUSTRALIA JOINS SAFETY-AT-SEA SERVICE

The Overseas Telecommunications Commission (Australia) has extended its safety-of-life-at-sea service by joining the Automated Merchant Vessel Report (AMVER) system operated by the U.S. Coast Guard. AMVER is an international maritime mutual assistance program which provides immediate aid to the development and co-ordination of Search and Rescue (SAR) efforts in many offshore areas of the world.

Merchant ships of all nations are encouraged to send sailing reports and predicted position reports voluntarily to the AMVER centre in New York, via selected radio stations. Information from these reports is fed into a computer which generates and maintains dead reckoning positions for the vessels. Information concerning the predicted location and Search and Rescue characteristics of each vessel known to be within an area of interest, called a Surface Picture (Surpic) is made available on request to recognised SAR agencies of any nation to be used during an emergency.

Sydney Radio (call sign VIS) has been chosen as the Australian link because it is the major Australian OTC coastal radio station, with worldwide communication coverage of international shipping. Sydney Radio will maintain a 24-hour listening watch and will greatly improve AMVER communications for ships sailing in the SW Pacific and Indian Ocean areas. Teleprinter facilities have been provided at Sydney Radio, which will communicate with the Department of Civil Aviation facilities at Sydney airport. DCA will process all the incoming messages from Sydney Radio, extract relevant information for their own safety-of-life-in air program, and then transmit this information to the captains of international airliners for pre-flight briefings, and also to the Coast Guard Computer Centre in New York, via Honolulu.



OTC engineers who visited the AMVER headquarters recently were given a practical demonstration of the system. The computer plotted a surface picture for a ship requiring assistance in a 200-mile radius in the West Pacific. The information processed in 57 seconds showed positions of 11 ships that could render assistance (see diagram). The information also contained data regarding radio and medical facilities on board the plotted ships. Previously only minimum information on the South Pacific and Indian Ocean areas were supplied to AMVER, whereas under the new arrangements with OTC participation reports will contribute significantly to safety of life at sea. ("Contact," Vol. 2, No. 2.)

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America's finest professional quality recording tape is now available in Australia at half the price of any other comparable tape.

All "brand five" tape has high remanence iron oxide emulsion coated on to the best quality acetate or Mylar base material. It is supplied with green/red leaders at both ends. There is no squeal, no gumming of heads and reduced head wear with "brand five" special dry synthetic lubricant which gives new protection for valuable equipment.

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Type No.	Description	Other Tapes	Our Price
	ON 7" REELS		
15D7	1200' 1.5 Mil Acetate	$6.25	$3.00
10D7	1800' 1.0 Mil Acetate	8.20	4.10
10D7M	1800' 1.0 Mil Mylar	7.70	3.85
5D7M	2400' .5 Mil Mylar	11.98	5.97
5D7MS	3600' .33 Mil Mylar	17.70	8.95
	ON 5" REELS		
15D5	600' 1.5 Mil Acetate	$3.60	$1.80
10D5	900' 1.0 Mil Acetate	4.70	2.35
10D5M	900' 1.0 Mil Mylar	5.50	2.75
5D5M	1200' .5 Mil Mylar	7.00	3.50
5D5MS	1800' .33 Mil Mylar	9.98	4.98

Type No.	Description	Other Tapes	Our Price
	CORRESPONDENCE TAPE ON 3" REELS		
15D3	150' 1.5 Mil Acetate	$1.20	$0.60
10D3	225' 1.0 Mil Acetate	1.65	0.82
5D3M	300' .5 Mil Mylar	1.98	0.98
5D3MS	450' .33 Mil Mylar	2.65	1.33
3D3MS	600' .33 Mil Mylar	3.25	1.60
	CORRESPONDENCE TAPE ON 3½" REELS		
3032MS	900' .33 Mil Mylar	$4.50	$2.25

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SCIENTIFIC AND INDUSTRIAL NEWS

Corrosion-proof exchange

The tourist resort of Rotorua, New Zealand, is being provided with a corrosion-proof telephone exchange worth nearly $1.4 million. Before the special exchange could be produced, atmospheric conditions in Rotorua had to be reproduced exactly in the Beeston, near Nottingham, laboratories of the Plessey Telecommunications Group in Britain, who supplied the exchange to the New Zealand Post Office. The atmospheric conditions at Rotorua — the centre of New Zealand's sulphur springs area — are so corrosive that the useful life of standard exchanges is only months.

Plessey engineers found that the main causes of trouble were hydrogen sulphide gas and a particularly abrasive type of dust carried on the wind from the thermal springs. This environment corroded the metal components, switches and relays, eventually causing their failure. Sulphide films formed on the silver contacts, while the hydrogen sulphide attacked the PVC used for panels, wire covering, etc. In the finished exchange, much of the more delicate equipment is enclosed in dust-proof cabinets, each with its own air-conditioning system. Where metal contacts are exposed to the atmosphere, palladium and other less-corrosive metals are used. A type of PVC formulated to be resistant to hydrogen sulphide is used.

Anti-submarine radar

A new British airborne radar provides information for the tactical control of an anti-submarine search using an operational plotting board. The equipment was developed for the Royal Navy by Ekco Electronics Ltd., Southend-on-Sea, Essex, England, in collaboration with the Ministry of Technology. The 17in square high-brightness projection screen displays an overall picture of a search and attack within a 50 mile radius, and provides the added advantage of identification of friend or foe. An illuminated parallel-line protractor is incorporated in the display to aid bearing measurements, while a map image can be superimposed on the screen.

High powered transistors

RCA Electronic Components of the U.S.A. is carrying out research with experimental transistors which could rival valves for power output. Although still in the laboratory stage, a transistor has been built with a new laminated construction that generates 800 watts at 1MHz. The laminated transistors are formed on two separate wafers of silicon, which are fused under heat and pressure into a single monolithic structure which incorporates ballast resistors to avoid secondary breakdown. The company is planning to develop devices giving more than 300 watts at 30MHz, and to increase power output of a sonar device up to 1 to 5KW with KV breakdown characteristics.

Automatic T.A.B.

The T.A.B. in Western Australia has installed a computer equipped with optical readers, data transmission terminals and visual display screens. Information on punters' bets from 50 metropolitan agencies are sent via Siemens keyboard data transmission terminals directly into an IBM system 360/model 30 configuration at the Control Centre in Murray Street, Perth. Other agencies transmit to the centre by phone where the information is marked on forms which are read by the computer. The computer automatically combines and logs all information received, verifies that all agencies have transmitted, and calculates dividends for outward transmission to the agencies.

The T.A.B. management can obtain information through three visual display terminals or through keyboard terminals which monitor the progress of betting, the reporting status of agencies, scratchings, results and dividends. An additional application is now being implemented whereby individual tickets are processed and transmitted direct from the agencies to the computer at the T.A.B. Control Centre. This obviates the need for sub-collating at the agencies, and permits details of individual tickets to be retained on file for each agency for pay-out, accounting, etc.

Emergency runway light

A cold-cathode discharge lamp, operating from 12V DC with a solid state inverter, has been developed as a safe and economical substitute for the so-called goose-neck kerosene flare as a portable runway light for emergency use. Known as the PERL (Portable Electric Runway Light), the unit has been developed by Hawker Siddeley Dynamics Ltd., Hatfield, Herts., England, in conjunction with the R.A.F. Central Air Traffic School. Tests have shown that PERL units have a visibility of eight miles from 1500 feet on a moonless night, while one lamp left in operation gave a satisfactory light after 26 hours.

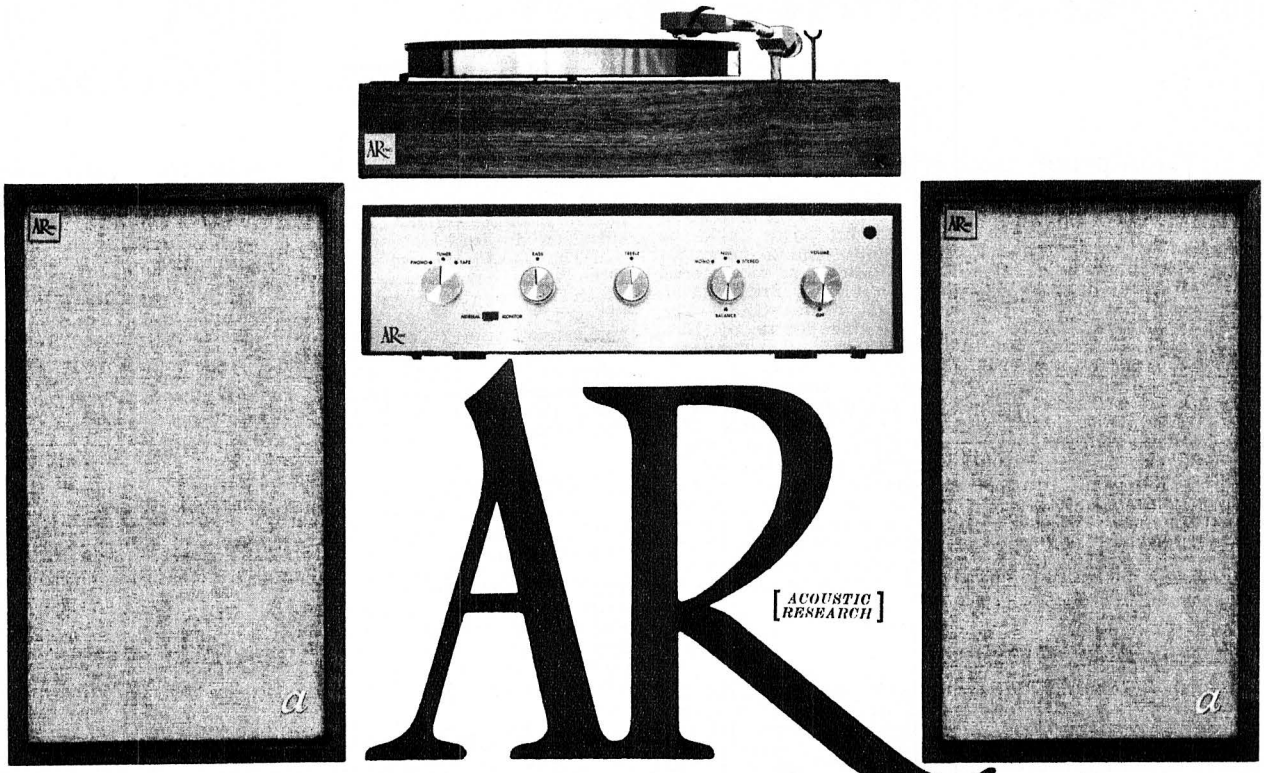
Satellite station in Kenya

A $2.5 million contract for the design, construction and installation of a satellite communication earth station in East Africa has been awarded to The Marconi Company, Chelmsford, Essex, England. The station, the first to go out to tender in Africa, will be at Mount Margaret, 27 miles north-west of Nairobi in Kenya's Rift Valley. It will have a 97ft diameter antenna, weighing over 100 tons, which will rotate on sliding surfaces of a synthetic material said to be more reliable and resilient than conventional metal bearings. This is of particular significance in the Rift Valley, which is subjected to an average of one major earth tremor every three years.

London's educational TV service

A teacher assumes the role of vision controller in the control room of a studio of ETV London, the Inner London Education Authority's educational television service. A regular service of educational programs is relayed to 300 schools in London (to be extended to 1500 in 1969) in what is probably the world's largest closed-circuit network. The service has a staff of 45 teachers trained in TV production.

America's BEST



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Developed in America, they are there popularly known as the finest available high fidelity systems. This is because AR equipment is designed to reproduce a musically natural sound—not one that is distorted or "pepped-up" —but one which, as the term "hi-fi" implies, produces the highest possible degree of fidelity to the original. This is true hi-fi. This is where AR components excel.

Experts, qualified to judge, and with facilities for a thorough and competitive testing, have stated:

AR Amplifiers: "delivered a staggering 110 watts per channel at the clipping point."

AR Speakers: "none quite as good at double the price." "have not encountered truer fidelity."

AR Turntables: "the wow and flutter were the lowest I have ever measured on a turntable."

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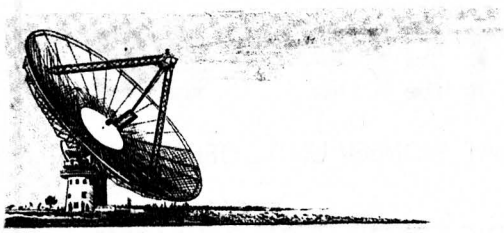


The station will be operated by the East African External Telecommunications Co. (EXTELCOMS), using a synchronous satellite of the Intelstat III series over the Indian Ocean. As the antenna is steerable, however, the station will also be capable of using synchronous satellites over the Atlantic.

Cooling method

An idea for motorless cooling, or refrigeration, requiring no electric power or other input of energy, has been taken up by the National Research Development Corporation of the U.K. to assess its commercial potential. The method was invented by Dr A. K. Head of the C.S.I.R.O. Division of Tribophysics, Parkville, Victoria. He realised that if a surface, exposed to a cloudless sky, could be made to radiate strongly in the long infrared wavelengths of about 8 to 13mm and reflect strongly at other wavelengths, there would be a net loss of radiant heat through the earth's atmosphere into outer space.

Surfaces with these radiation characteristics can be made, for example, by depositing a very thin layer of silicon monoxide on a highly polished surface of aluminium. Using available equipment, Dr Head has carried out experiments on a small scale which confirms a cooling effect does occur in practice.

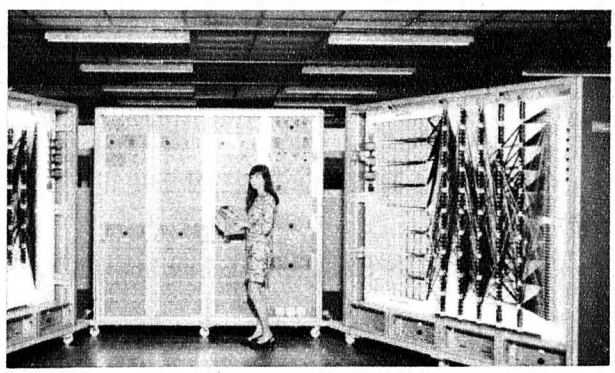
Superconducting magnet

A superconducting magnet, patented in the U.K. recently, consists of a hollow tube, around the axis of which currents circulate to form a single-turn solenoid. The magnet is energised by subjecting a small part of the wall to a localised transverse magnetic field, strong enough to penetrate the wall. Moving the field along the wall, and then removing it, leaves a magnetic field, parallel to the axis, trapped within the tube. This sets up currents which circulate around the tube axis, continuing after the localised field is removed. Better packing can be obtained than with wire-wound devices, and concentration of current close to the axis could reduce the material required for a given field.

Electron-beam semiconductor

An electron-beam PN junction device was described by Dr C. B. Norris, a scientist from Stanford University, at an IEEE conference in the U.S.A. recently. It involves bombarding a silicon beam lumped diode with 10KeV electrons from a beam modulated tube structure. The beam diode, using ion implantation techniques, is designed to be sensitive to an electron beam. The basic device is a wide-band amplifier with a gain of several thousand, a rise time as low as a fraction of a nanosecond, and a power output of from 1 to 100KW. The unit is now in prototype production.

Electronic post coding



An advanced electronic system, designed for Britain's first fully automatic postal sorting office, is seen at the Plessey Automation Group factory at Poole, Dorset. Known as a coding desk translator, it substitutes written postcodes and addresses with a code that can be read by machines used for automatic mail handling. The equipment is claimed to be able to translate about 2000 addresses a second.

Heat shrinkable sleeve

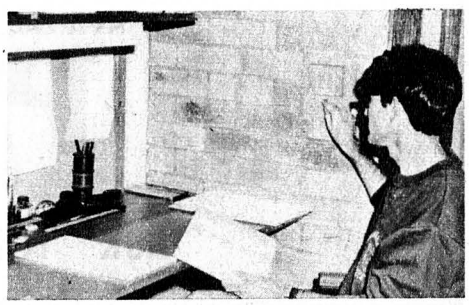
A sleeve to cover and seal joints in pipeline systems is available from W. R. Grace Australia. Ltd. It is designed to protect these vulnerable points from all corrosion and moisture penetration. Called the "Canusa" sleeve, it is a heat shrinkable cross-linked polyethylene tube with an adhesive thickly covering its inner surface, and is compatible with all forms of pipe coating. Application of heat quickly shrinks the sleeeve uniformly around the pipe and joint, gripping tightly and forcing the adhesive into all cracks, interstices and pipe irregularities. The sleeved joint becomes a tough coating covering the weld area.

Fibre optics in the home

Flexible glass fibre optics are planned to provide illumination for several home entertainment systems, including radios, TV receivers and phonographs, to be introduced in 1969 by several manufacturers, according to a Corning Glass Works spokesman. Among the applications is a movable point of illumination to indicate the position of radio dial pointers. Another is the provision of a point of cold light near the stylus of a phonograph arm to enable accurate manual selection of desired tracks on long-playing records. Additional information about glass fibre optics is available from Corning Glass Works, 1202 Plaza Building, Australia Square, Sydney.

College communications

The University College of Townsville has a specially designed communications system that enables individual students to be contacted throughout the collage. The system was devised and installed by the C.S.A. (Communications Systems of Australia) Division of Plessey Pacific. A master console in the college's administration office is linked to two-way communication units in bedrooms, common rooms, bathrooms and laundries. The console operator can locate a student by calling individual units or by paging through all units simultaneously. The system can also be use as a public address network to direct messages to students.



Left, the master console in the college's administrative office. Right, a student answers a call to his room. Similar two-way communication units are located at key points throughout the college.

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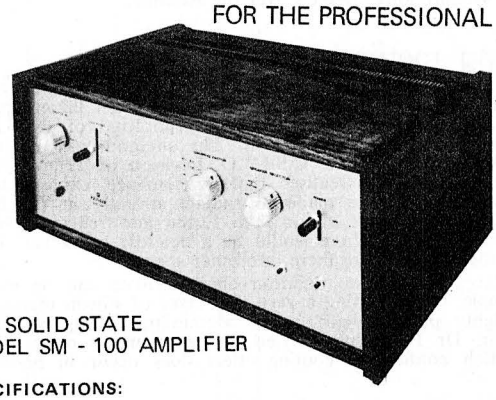
SPECIFICATIONS:

Audio Section	
Music Power	40 watts total at 4Ω
RMS Power	15 watts per channel at 4Ω 12 watts per channel at 8Ω
Harmonic Distortion	Less than 1%(at 1 kHz rated output)
Frequency Response	3 db, from 20 Hz to 70 kHz
Power Bandwidth	30 Hz to 20 kHz (AUX)
Hum & Noise (at rated output)	MAG: better than 75 db AUX: better than 85 db
Inputs and Audio Sensitivity	MAGnetic PHONO: 3 mV TAPE MONITOR: 130 mV AUXiliary: 130 mV
Output Terminals and Jacks	Speakers: 4-16 ohms Stereo headphones jack, Simultaneous tape recording jacks, equipped with TAPE MONITOR switch Tape recording/playback jack (DIN standards)
Speaker Switch	A or B speakers
Equalization Curves	PHONO: RIAA
Tone Controls (each channel)	BASS: boost 13 db, cut 11 db (at 50 Hz) TREBLE: boost 9.5 db, cut 10 db (at 10 kHz)
Loudness Contour	Switchable to ON-OFF, boost 12 db at 50 Hz, boost 6 db at 10 kHz, with VOLUME control set at -40 db
FM Section	
Circuitry	Front end using "F.E.T."
Frequency Range	87 - 108 MHz
IHF Usable Sensitivity	2.5 μV
Image Rejection	55 db (at 98 MHz)
Signal to Noise Ratio	50 db (IHF rating)
Antenna Input	300 ohms (balanced)
Multiplex Section	
Circuitry	Time-switching type de-modulator FM/MONO stereo Automatic Selection
Channel Separation	35 db (at 1 kHz)
AM Section	
Circuitry	Superheterodyne
Frequency Range	525 - 1605 kHz
IHF Usable Sensitivity	8 V
Image Rejection	47 db (at 1000 kHz)
Antenna Input	Built-in Ferrite Loopstick Antenna
Power Supply	240 volts 50 Hz

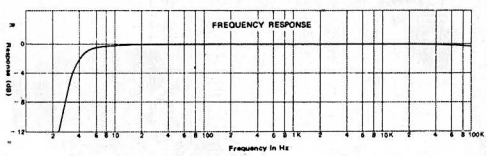
FOR THE PROFESSIONAL



ALL SOLID STATE
MODEL SM - 100 AMPLIFIER

SPECIFICATIONS:

Music Power:	210 watts (at 4Ωload)
RMS Power:	90 watts per channel (at 4 load)
Frequency Response:	5 Hz to 100 kHz 1 dB
Power Bandwidth:	10 Hz to 30 kHz (harmonic distortion, 0.5% constant, IHF)
Harmonic Distortion:	Less than 0.5%at RMS Power/1kHz
S/N ratio:	110 dB or more (input attenuator 0 dB, low-cut filter off, input terminal terminates at 100 KΩ, at RMS power)
Residual Noises:	1 mV8 (input terminal terminates at 100 K , low-cut filter, off)
Input Attenuator & Gains: (Input voltages for RMS power)	0 dB 1 V (100 KΩ) 6 dB 2 V (100 KΩ) 14 dB 5 V (100 KΩ)
Damping Factor:	8Ω: 1, 5, 7, 50 16Ω: 3, 14, 100
Output Terminals: (2 pairs of output speaker terminal)	Speakers; 4-16Ω
Low-cut Filter:	5 Hz: — 16 dB/oct 20 Hz: — 10 dB/oct
Muting:	For the first 4 seconds after the power is turned on.
Transistors:	32
Diodes:	15
Power Supply:	230 Volts 50 Hz AC
Power Consumption:	296 Watts
Dimensions:	16-1/2"(W)x6-3/4"(H)x11-3/4"(D)



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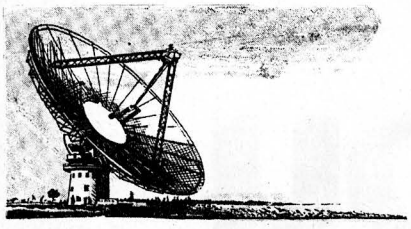
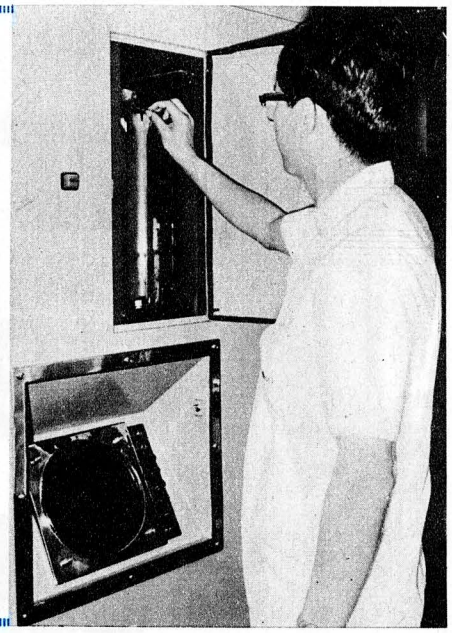


Cable jointing machine

A jointing machine to speed up the laying and maintenance of telephone cables has been developed by the British Post Office and the Plessey Co. In the new machine the two wires to be jointed no longer have to be stripped of insulation, but are simply placed in a slot and a switch depressed. A metal connector, externally insulated, 18mm long with internal piercing tongs, is crimped over the wires making electrical contact while knives on the machine cut off unwanted ends automatically. A joint takes 3 seconds compared with 25 seconds by the present hand method.

Automatic cancer diagnosis

Developed jointly by the Medical School of Osaka University and Tateishi Electric Co. of Kyoto, Japan, the Omron Cancerous Cell Automatic Diagnoser has ben used for group tests of cancer at the university. The automatic diagnoser focuses a spotlight on the cells to be examined, and locates the cancerous ones by the amount of light that penetrates their nuclei — the nuclei in cancerous cells are abnormally larger than those in normal cells. The automatic diagnoser can take 200 coloured glass slides with the cells to be examined for continuous diagnosis. A computer classifies the nuclei into five groups according to their size, and records the total number of each group.



A glass slide with the cells to be examined is placed in the automatic diagnoser.

Permanent magnet

Scientists at Bell Telephone Laboratories in the U.S.A. have cast solid permanent magnets from material containing rare earths such as cerium and samarium These magnet materials are said to have the highest coercivity of any known materials of comparable magnetic properties. The new magnets are made by melting cobalt, copper, iron and either cerium or samarium on a water-cooled copper hearth in an arc furnace filled with argon gas. Discs formed in this way are then magnetised with poles on the surface on both sides.

Solid state welder

An MIG (Mechanised Inert Gas) welding plant using solid-state circuitry has ben introduced by Commonwealth Industrial Gases Ltd., 138 Bourke Road, Alexandria, N.S.W., 2015. Known as the EMP Trans-MIG 600, it is available in thre basic sizes catering for all automatic and semi-automatic open arc processes. Use of semiconductors in the design of the power source and wire feeder is claimed to provide greater precision and ruggedness than earlier MIG welding plants.

Power cable colours

Following agreement between most countries of Europe, including the U.K., the International Commission on Rules for the Approval of Electrical Equipment (C.E.E.) has revised the colour coding of the power cable for domestic electrical appliances. The new colours are: live — brown; neutral — light blue: earth — green and yellow striped. Up to a date to be specified — January 1, 1970, has ben proposed — the present standard will also be permitted.

Piezoelectric transformer

A television EHT or line-flyback transformer using a piezoelectric element has been developed by Matsushita Electric of Japan. An input voltage fed to a driving section makes the piezoelectric bar vibrate. This activates a generating part of the bar, from which an output of 10KV can be taken. The transformer is about a quarter the size and weight of a conventional unit.

ITU appointment

Mr Richard E. Butler, Deputy Assistant Director-General of the Australian Post Offic, was elected Deputy Secretary-General of the International Telecommunication Union (ITU) at the 23rd session of the Administrative Council on May 27, 1968, and took up his official duties on October 1. Mr Butler has participated in many ITU conferences, and was a member of the Australian delegation in the negotiations for drafting agreements for the International Satellite Communication Consortium (Intelsat.)

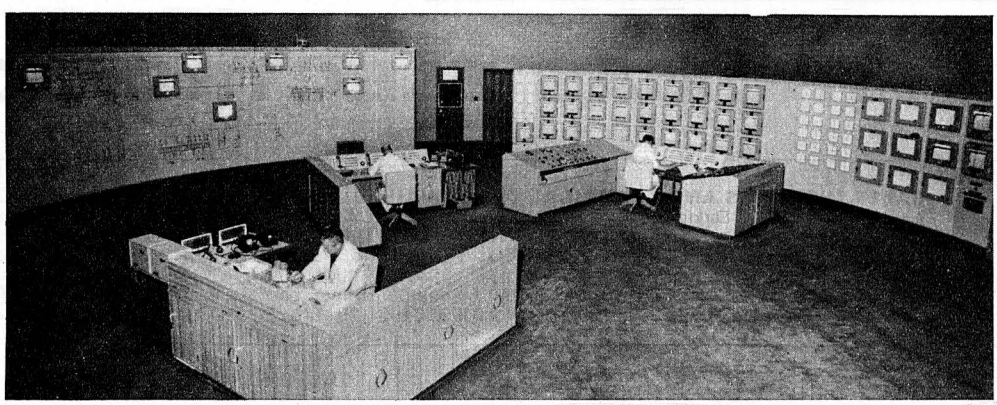
Paper transistors

The Westinghouse Electric Corporation, of the U.S.A., has developed thin-film transistors printed on paper, plastic or aluminium foil. The transistors, demonstrated at Wescon 68 in Los Angeles, are made by evaporating the component materials individually through metal masks or stencils. They are built up by four vapour deposits — which could typically

Electricity control centre

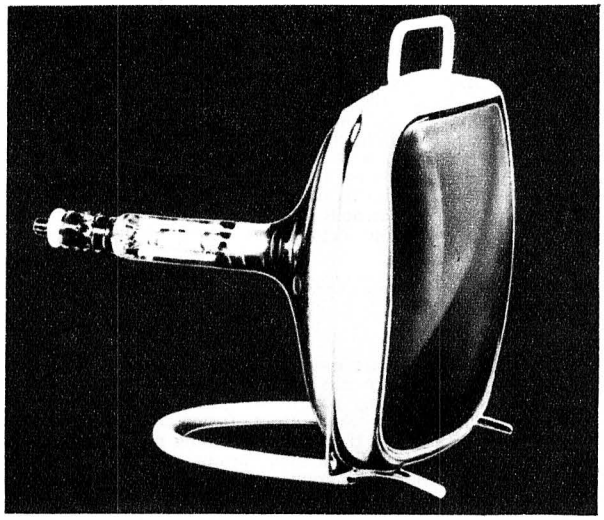
The N.S.W. Electricity Commission has built up a control system to deal with all foreseeable causes of failure. This system is being improved continually, and over $1 million will be spent this financial year on telecommunications and control systems. Overall control of the electricity supply to the whole of the State is from the control centre at Carlingford, near Sydney.

A mosaic diagram shows the main high voltage system, which lines or equipment are out of action, the power flowing in important lines, and provides remote control of important switches. A load dispatching panel displays information about the system frequency and the output from power stations. A computer, associated with the load dispatching panel, controls automatically the loading of the main power stations' generators for maximum overall economy. Each control desk has direct contact with key parts of the system.



The control room of the N.S.W. Electricity Commission's system control centre at Carlingford, showing (left) the mosaic diagram and (right) the load dispatching panel.

Are you wasting time?



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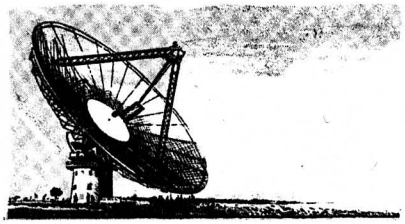


be gold, tellarium (a semi-conductor), glass and aluminium — to give flexible transistors less than one hundred-thousandth of an inch thick.

Senate favours metric

A Select Committee of the Australian Senate has recommended that Australia should adopt the metric system of weights and measures. It also recommends that the system to be adopted should be based on the International System of Units (SI), as in the U.K., and that a Metric Conversion Board be set up. A conversion period of ten years from the date of the Australian Government's announcement of intention to convert is proposed.

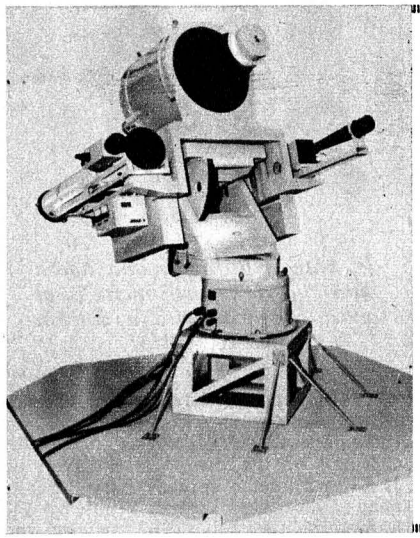
tures and energy of particles. ESRO I was developed for the European Space Research Organisation by Laboratorie Central de Telecommunications (LCT), a French associate of ITT.

Making infrared visible

A phosphor lamp coating that converts infrared radiation into visible light was announced recently by scientists of the General Electric Co., New York, U.S.A. The new phosphor has been used in a gallium arsenide solid-state lamp to produce green light. The lamp, called the SSL3, is still being lab-tested and consists basically of an infrared source coated with a specially activated lanthanum fluoride. It has switching capabilities of the order of 1000 times per second, and lab tests indicate a life of about 20,000 hours.

Emergency electrocardiogram

An instrumentation system developed by NASA in the U.S.A. is being used as an emergency ambulance aid in California and Los Angeles. In the system, slim bare wires are applied to the skin using a quick drying silver-glue without the need to shave the skin. Electrocardiograms obtained with the aid of these wires are relayed over a conventional radio link to a hospital while the patient is en route to that hospital, allowing necessary preparations to be made in advance.



Laser tracking system

An experimental laser system for high precision tracking of artificial satellites has been developed by Hitachi Ltd., Tokyo, Japan. The ruby laser emits extremely short pulses with a peak power of 5 megawatts at an average repetition rate of one per second for a maximum duration of six minutes. The system, said to be 10 times more accurate than conventional radio tracking devices, will be put to experimental use with satellites fitted with laser reflectors. Japan's first laser tracking program will be carried out jointly by Hitachi and the Tokyo Astronomical Observatory.

Cheyenne helicopter

The new U.S. Army Cheyenne armed helicopter demonstrated successfully its computerised firepower system in test firing flights at the Potrero range of the Lockheed Propulsion Co. near Redlands, California. The Cheyenne's six-barrel minigun is aided by a computer, a high-powered telescopic sight in a swivelling gunner's station, and a heading and attitude reference system. A 40mm grenade launcher is interchangeable with the minigun on the flexible nose turret.

Commercial TV at Broken Hill

A commercial television station was opened at Broken Hill, N.S.W., by the Postmaster-General on September 20, 1968. The station, operated by Broken Hill Television Ltd., has the call BKN and operates on Channel 7 with vertical polarisation.

ESRO I launched

The ESRO I scientific satellite has been successfully launched by a Scout Launcher from the U.S. Air Force Western Test Range at Vandenberg, California. The 183lb satellite has a payload consisting of eight experiments dealing with auroral photometry, ionic density, and temperature

Trans-African radio link

A 2,500-mile east-west radio link carrying several telephone and telegraph channel between Addis Ababa, Ethiopia, and Abidjan, Ivory Coast, was brought into service recently. It was inaugurated by a conversation between H.M. the Emperor Haile Selassie of Ethiopia and the President of the Republic of the Ivory Coast, H.E. Houphouet-Boigny. This link is of particular importance to African development, and was included in the general development plan for the international network in Africa by an ITU Committee in 1967.

Inertial navigation system

An automatic inertial navigation system manufactured by Litton Industries, Beverly Hills, California, U.S.A., has been selected for the pre-production Concorde. The system, type LTN-51, will be installed in triplicate in the Concorde, with cross-monitoring to achieve the maximum attainable reliability. It will be certificated as the primary means of navigation and primary source of attitude and heading reference in the Concorde. ■

A Solid State Volt-Ohm Meter

Our latest test instrument design is a solid-state equivalent to the familiar "VTVM", and offers all the advantages of the latter together with increased sensitivity, virtually instant warm-up, and complete independence from the power mains. These features, together with simplicity and low cost, should make it a popular project.

by Jamieson Rowe

The familiar VTVM is widely used for making circuit voltage measurements in electronics workshop and laboratory situations, and is particularly suited for this task by virtue of its ruggedness and high input impedance —typically around 10M. However, the usual VTVM is a mains-powered instrument, and cannot be used easily either in situations remote from the power mains, or to measure potential differences which are "floating" with respect to earth. It also requires some 5 to 10 minutes "warm-up" following switch-on, before the internal thermionic valves and associated circuitry stabilise sufficiently to permit accurate and reliable measurements.

The solid-state instrument to be described in this article offers virtually all the advantages of a VTVM, together with some important new performance features. It has an extended DC sensitivity—down to 1V FSD, an effective "warm-up" time of but a few seconds, and complete independence from the power mains. The last-named feature permits the instrument to be used not only for making measurements "in the field" remote from the power mains, but also allows it to make measurements which are fully "floating" with respect to earth.

Despite these added features the new instrument is no more complex than the usual VTVM, and if anything should involve a slightly lower initial cost. It should thus prove a most popular project, and a useful addition to either the home workshop, the service shop or van, or the development lab.

At the heart of the new instrument is a balanced-bridge DC amplifier circuit rather similar to that of a conventional VTVM, but using two junction field-effect transistors (JFETs) instead of a double triode valve. As with the VTVM, the DC amplifier effectively converts a standard 0-1mA/100 ohm meter movement into DC voltmeter having an extremely high input resistance.

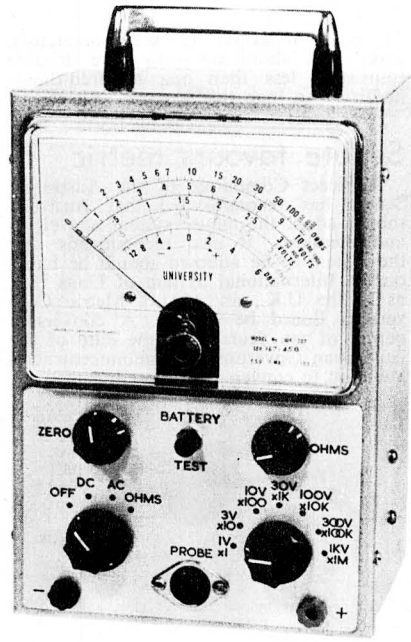
The JFET is a relatively new semiconductor device, and one whose operation is actually closer to that of a thermionic valve than to a conventional "bipolar" transistor. In contrast to the bipolar transistor it is a voltage-controlled device rather than one which is current-controlled, and has the very high input resistance of a reverse-biased semiconductor P-N junction rather than the relatively low input resistance of a forward-biased junction.

The principles of JFET operation have been described in some detail by the author in previous articles (February, 1967, pp.85-87; also July, 1967, pp.36-46). Briefly, its operation involves the control or modulation of the conductance of a relatively narrow strip of semiconductor material called the **channel,** by means of a transverse electric field produced by an adjacent semiconductor electrode called the **gate.**

At the ends of the channel are the **source** and **drain** electrodes, corresponding roughly to the cathode and plate respectively of a thermionic valve. An input voltage applied to the gate electrode is accordingly able to control any channel current flowing from source to drain, in a rather similar fashion to that whereby the bias voltage at the grid of a valve is able to control the cathode-plate current.

It has been possible for some time to produce a solid-state instrument equivalent in performance to the VTVM, using bipolar junction transistors. However, almost of necessity such instruments must be rather complex and expensive, mainly due to the measures required if the inherently low input resistance of bipolar devices is to be overcome without prejudice to stability or reliability.

The very high input resistance of the JFET device renders it considerably better suited for this type of application, so that in theory the release of modestly priced JFETs some two years ago should have enabled designers to produce solid state volt-ohm meters which compared favourably with the VTVM, not only in terms of performance but also in terms of relative simplicity and low cost. But in general this was not the case, mainly because the principal behaviour parameters of the JFET devices initially released



In both appearance and operation the new instrument is almost identical with a conventional VTVM.

were subject to production spreads which were embarrassingly wide for this and similar applications.

Many of the problems incurred by JFET parameter spreads have already been discussed in some detail by the author in the July 1967 article, and readers who wish to pursue this matter further are referred to the earlier article. For the present, it is perhaps sufficient to note that the first economy devices released had a zero-bias source-drain current (Idss) spread range of a full decade (3-30mA), together with a slightly greater range for the nominal pinch-off voltage Vp (0.75-10v).

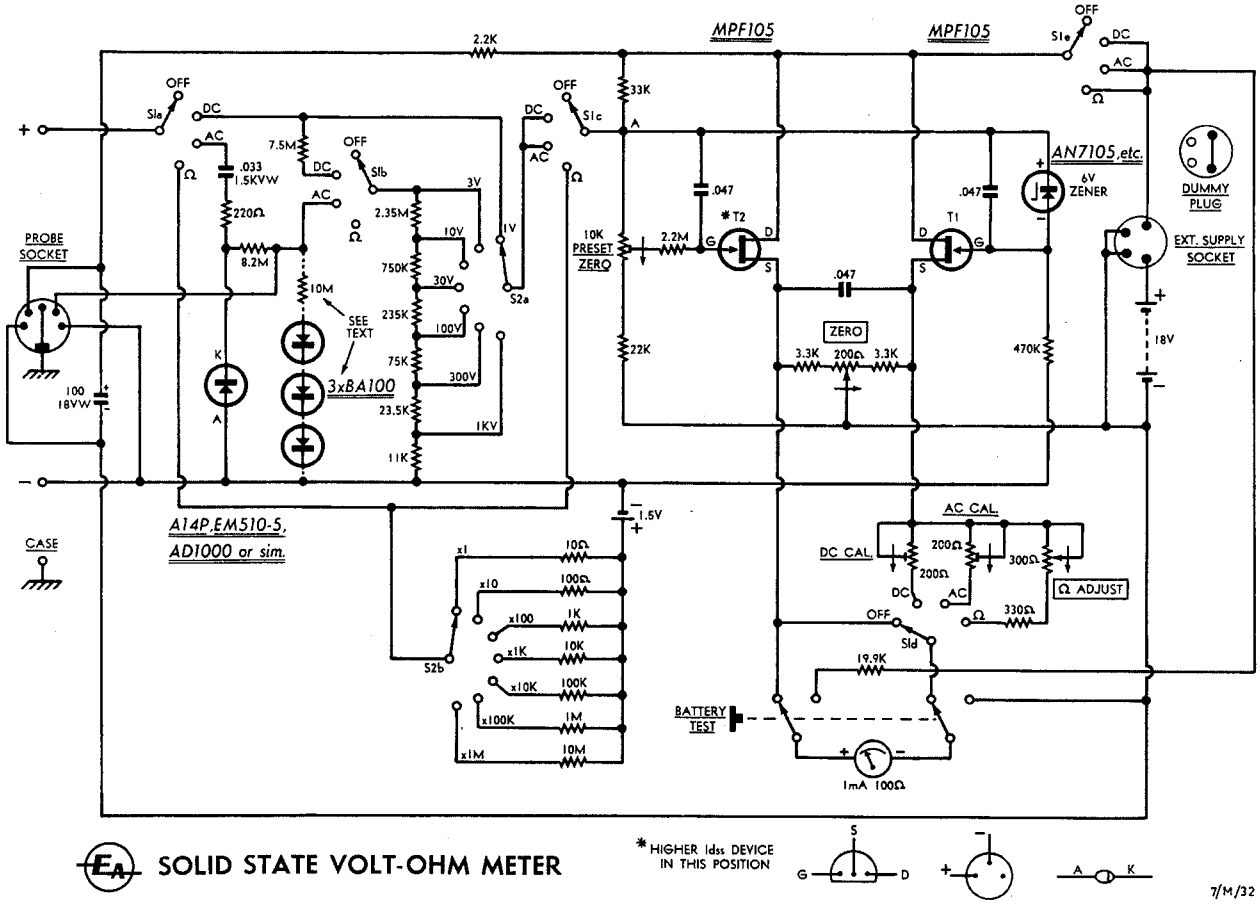
Until recently, then, the would-be designer of a solid state volt-ohm meter faced the frustrating situation wherein he was effectively prevented from producing a simple and economical design largely because the very devices which were in theory almost ideal for the job were subject to "incidental", but nevertheless very real, spread problems.

Few situations remain static in contemporary electronics, particularly those concerning semiconductor devices, and as one might infer correctly from the appearance of the present article, the foregoing situation has happily changed for the better in recent months. In short, there are JFET devices now available at economy prices whose parameter spread range is considerably narrower than those previously available.

The particular device which has been used in the new instrument is the

SPECIFICATION:

A portable high input impedance volt-ohm meter, employing two silicon junction field-effect transistors (JFETs) and five diodes. Input impedance on all DC and AC voltage ranges is approximately 10.9 Megohms shunted by a few picofarads. Seven DC ranges covering the range 1V—1000V FSD, and six AC ranges covering the range 3V—1000V RMS, both in 10dB range steps; seven resistance ranges covering from 10 ohms—10 Megohms centre-scale. Power consumption is less than 150 milliwatts, supplied by either an internal 18V battery or an external supply.



The circuit of the instrument bears a strong resemblance to that of the familiar VTVM, with a pair of silicon JFET devices replacing the usual double triode valve, and a silicon diode in place of the usual valve rectifier. The zener is for overload protection of the active transistor T1, and must be a low-leakage type to avoid input shunting.

Motorola type MPF105, an N-channel device which has an Idss spread range of only 4:1 (4-16mA), and a similar range for Vp (2-8V). While still not small, even by semiconductor standards, these ranges represent a significant improvement over those of the devices available earlier.

The MPF105 is also significantly superior to earlier devices in terms of the gate reverse leakage current Igss, which parameter plays a big part in determining the DC stability of the device in voltmeters, and similar applications wherein the gate circuit resistance must be kept high. Whereas earlier JFETs had a maximum Igss of some 10nA at 25° C, the MPF105 has a maximum Igss—at the same temperature—of only one-tenth this figure.

Using the MPF105 device, and by careful design, we have been able to produce a solid state volt-ohm meter which compares very favourably with the conventional VTVM, in terms of both performance and cost.

The instrument has an input impedance on both the DC and AC measuring ranges of greater than 10 Megohms shunted by a few pF, while the amplifier linearity is considerably better than any meter movement likely to be used. Zero drift and basic calibration drift from switch-on are virtually negligible, and are each stable typically to better than 1 per cent up to 40° C (104° F) ambient. Even at the rather unrealistic ambient temperature of 50° C (122° F) they will each typically be within approximately 3 per cent, which should be more than acceptable for the majority of applications.

Power consumption of the instrument is very modest, at around 150 milliwatts: it draws a mere 7-8 milliamps from an 18V supply, and is therefore capable of very economical battery operation. Using the nominal 15oz 18V battery specified (Eveready type 2512 or similar), the useful battery service life should be more than 200 hours. In addition to the main internal battery the instrument also employs a nominal 1.5V cell for the resistance ranges, as does the usual VTVM.

Provision has been made for alternative operation of the instrument from an external (floating) 18V supply, so that the internal battery may be conserved if desired when the instrument is used on the workbench or in similar situations wherein mains power is available. Connection of an external supply is facilitated by a simple plug and socket at the rear of the instrument case.

Reference to the main circuit diagram should assist in understanding the operation of the new instrument. The heart of the circuit is the balanced-bridge DC amplifier centred around JFETs T1 and T2, which may be recognised as rather similar to the equivalent section of a VTVM.

T1 and T2 are each connected in the "source-follower" configuration across the 18V supply, with the meter movement connected between the two sources via the usual calibrating multiplier resistors. Each JFET has a source load, consisting of a 3.3K resistor together with part of a shared 200 ohm potentiometer which functions as a differential load vernier for quiescent balancing or "zero" adjustment.

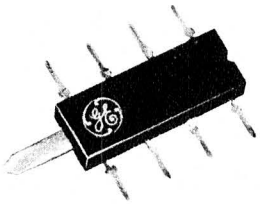
Device T1 is actually the "input" or active arm of the bridge, although this may not be immediately apparent from the circuit. The quiescent operating current of T1 is determined by a fixed forward bias derived from tap "A" on a resistive divider across the power supply, and applied to the gate of T1 via the input attenuator system.

A similar forward bias is applied to the gate of the balancing device T2, via a 2.2M series resistor which approximately matches the average attenuator resistance in the gate circuit of T1. As may be seen the bias for T2 is not fixed, but is variable over a range of some 3V extending negative from divider point "A." This has been done to enable the circuit to accommodate even worst-case differences between the devices used for T1 and T2, in terms of the spread variations in Idss and Vp.

Briefly, the reasoning behind this is that for accurate balance of the circuit, as indicated by a meter reading of zero with no input signal applied and the vernier load pot in mid-position, the two JFETs should draw equal channel currents. This will occur automatically if the two devices are

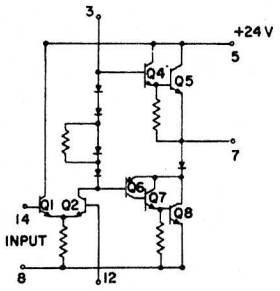
New Ideas in Consumer Electronics

A complete line of monolithic integrated circuits in plastic dual-in-line packages. Increased reliability, lower cost.



Take advantage of the PA 237's 9-27 volt supply range for application versatility.

PA237 is a silicon monolithic audio amplifier that can be used in your applications and save you money. It's capable of converting 8mV of input signal



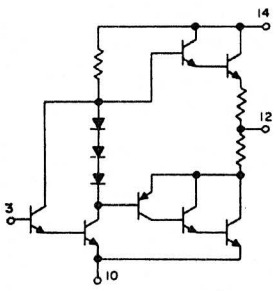
to 2 watts of continuous, low distortion output power.

PA237's feedback can be applied to the amplifier to allow adjustment of stability, input/output impedance, and amplifier sensitivity. AC and DC feedback networks are employed to provide excellent stability with frequency and temperature. Use the PA 237 in tape recorders, TV, FM receivers, record players, and dictating equipment.

Check GE(U.S.A.)'s low-cost 1 watt audio amplifier for your consumer applications.

GE(U.S.A)'s PA234 monolithic IC delivers 1 watt of continuous power to a 22-ohm load from a 22-volt supply. Its low cost plus the least number of outboard components of any audio amplifier on the market makes the PA234 the most economical alternative for achieving 1W of audio power.

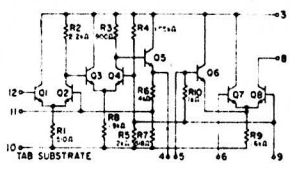
Applications range from record players, and TV to AM/FM receivers.



A low cost IC with gain of 75db to meet TV sound IF requirements.

GE(U.S.A.)'s 12 volt IF Amplifier/ Discriminator is designed for good AM rejection, audio recovery and very high gain. The PA189 integrated circuit operates at 5.5 MHz or 10.7 MHz and features gain of 75db at 5.5 MHz with as small a signal as 200 microvolts to meet TV sound IF requirements. PA189 5MHz typical band width (chart) is designed for most consumer sound applications. These include TV limiter detector audio amplifiers, FM radio pre-amps, and chroma-reference oscillators.

PA189 coupled with GE's PA237,

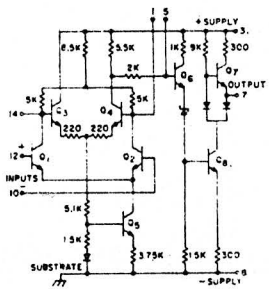


2 watt audio amplifier provides an excellent TV ground system with an optimum cost versus performance ratio.

A high gain IC you can use as an audio preamp or operational amplifier.

GE PA230 is a low level amplifier specifically designed to be used as either an audio preamp or operational amplifier. It offers high open loop voltage gain of 7K typical/12K maximum. Also the PA230 features output short circuit protection, low noise, and excellent sensitivity.

Use the PA230 in such applications as tape cartridge



recorder/players, Hi-Fi equipment, dictating equipment or for any audio products where low input sensitivity and reliability are of primary importance.

GE(U.S.A.) also offers a lower cost version of the PA230. The PA238, an operational amplifier, features expanded operating temperature range (−55° to 110°C), ±6/12 volt supply, and short circuit protection.

GE(U.S.A.) also offers a full economy line of silicon planar transistors. These include Small and Large Signal Amplifiers and High Frequency Amplifiers, Monolithic Darlington, and Power Transistors.

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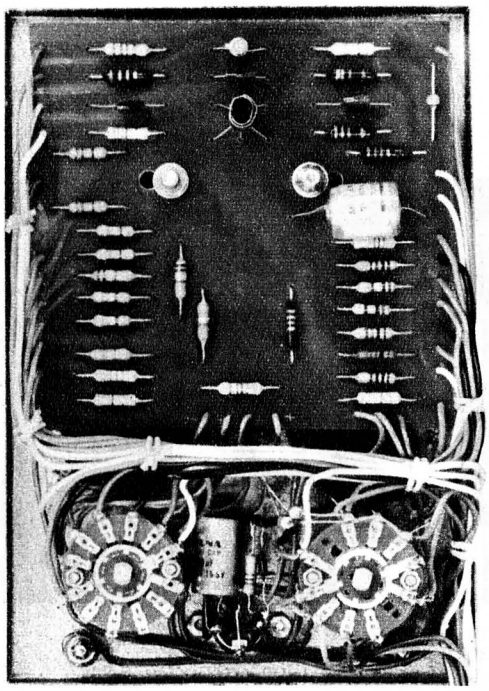

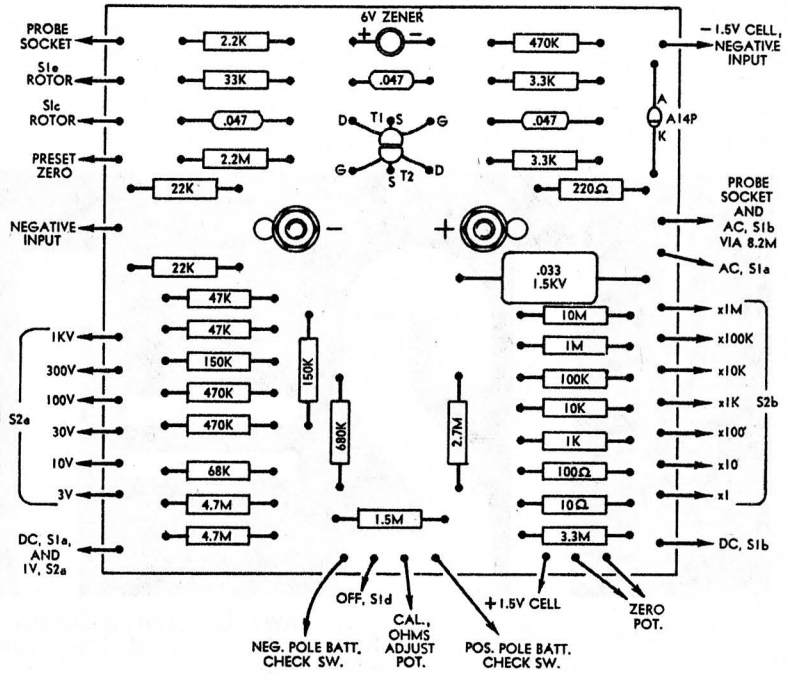

Above left is a view of the rear of the front panel of the meter, showing the printed wiring board and switch wiring. The board diagram above should aid in component placement and in making the various connections to the switches.

matched and if they are presented with the same forward bias voltage; however, with devices purchased as "unmatched" it is far more likely that for equal channel currents one will require a lower forward bias than the other. In other words, the device with the higher Idss figure must be effectively "biased back" with respect to the other if the two are to draw equal quiescent currents.

When the two devices are operating at equal channel currents Id, the ratio Id/Idss for the device with the lower Idss will naturally be greater than that for the device with the higher Idss. It follows that the former device will tend to display a higher transconductance, because the transconductance of a JFET is proportional to the square root of the ratio Id/Idss. Hence since the linearity of the voltmeter amplifier will be at least a partial function of the transconductance of the "input" device T1, it is the device with the lower Idss, which should be used in this position.

Conversely it is the device with the higher Idss which should be used in the T2 position, and therefore the T2 device for which adjustable gate bias should be provided to allow coarse circuit balancing.

Although it might seem from the foregoing that it would be necessary to measure the Idss currents of the two devices concerned before they could be connected into circuit, this is not necessary. As will be described in greater detail later, the correct positions for any two MPF105s can be found quite simply and rapidly by trial and error: there are only two possible combinations, so that if balance cannot be achieved with one it is simply a matter of reversing to the other.

In order that the amplifier circuit should be capable of driving the meter movement linearly to full-scale deflection with any MPF105 device in the T1 position, the source load resistances of T1 and T2 and the forward bias on T1 have been chosen to given the highest quiescent channel current Id compatible with correct operation of all devices at temperatures to greater than 50° C. Consequently the input voltage of the instrument is arranged to reduce the current of T1 from Id, for positive meter deflection, and this explains why the gate of T1 connects to the negative input polarity while the positive input polarity ultimately connects to the bias tap "A".

The 470K resistor and 6V zener diode associated with the gate of T1 are designed to protect the JFET from damage if the instrument is connected to excessive and/or reverse polarity input voltages. The zener may to some extent be regarded as optional "added insurance," as the current limiting provided by the resistor is possibly sufficient to prevent damage to T1 in almost all likely overload situations; however, the additional protection provided by the zener is recommended as worthwhile in view of the modest outlay involved.

Three 0.047uF capacitors associated with the gates and sources of T1 and T2 perform high-frequency bypassing, and render the instrument virtually insensitive to AC signals superimposed upon the input voltages being measured.

The input switching and attenuator system of the new instrument is very similar to that of a conventional VTVM. There are only two control switches, a function/power switch S1 and a range switch S2. The former has four positions, Off-DC-AC-Ohms; while the latter has seven positions, covering the range 1V-1KV for DC voltage measurement, and the range 10 ohms —10M (centre scale) for ohms measurement. Only six of the seven

List of Components

1 Instrument case, 7½in x 5in x 4in, with flanged front panel.
1 Printed wiring board, 68/m12, 4½ inches square.
1 Set case hardware (handle, rubber feet, screws, etc.).
1 0-1mA meter movement, 4in rectangular, 100 ohms, with standard VTVM scales.
1 Rotary switch, 3 sections 2-pole 4-positions.
1 Rotary switch, 2 sections 1-pole 7-positions.
1 Microswitch button, DPDT spring return.
1 18V battery, 15oz size.
1 1.5V cell, "type D."

SEMICONDUCTORS
2 MPF105 n-channel JFETs.
1 AN7105 or similar low leakage 6V zener diode.
1 A14P or similar 1000V rectifier diode.
3 BA100 or similar silicon diode.

RESISTORS
5% ½watt type: 220 ohms, 330 ohms, 2.2K, 2 x 3.3K, 2 x 22K, 33K, 220K, 470K, 2.2M.
High stability close tolerance (see text): 10 ohms, 100 ohms, 1K, 10K, 2 x 22K, 2 x 47K, 68K, 100K, 2 x 150K, 2 x 470K, 680K, 1M, 1.5M, 2.7M, 3.3M, 2 x 4.7M, 8.2M, 10M.
Potentiometers: 1 x 200 ohms lin. or WW; 2 x 200 ohms preset, lin. or WW; 1 x 300 ohms lin. or WW; 1 x 10K preset, lin. or WW.

CAPACITORS
1 .033uF 1.5KV plastic.
3 .047uF LV plastic.
1 100uF 18VW electrolytic.

MISCELLANEOUS
5-pin DIN socket, polarised 4-pin socket and plug, 3 x banana jacks (red, black, green), 4 x control knobs, scrap aluminium for battery clamp and preset pot bracket, connecting wire, solder, etc.

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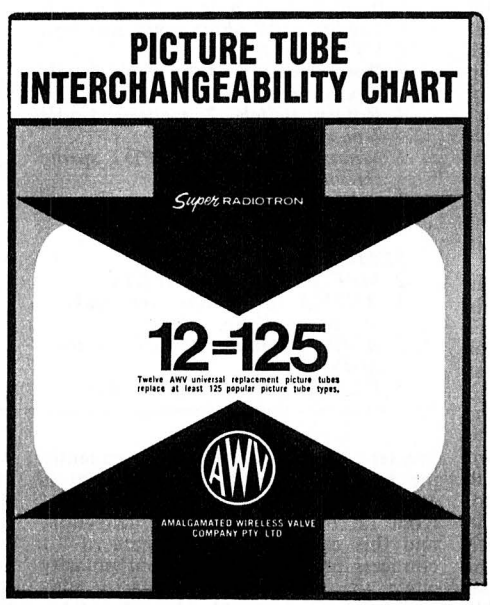

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positions provided by S2 are used for the AC voltage ranges, the 1V position becoming inoperative for this function.

It may be noted that in contrast with a conventional VTVM, there is a single "DC" function rather than two of opposite polarity. The reason for this is that the instrument is capable of "floating" with either or neither input terminal earthed, and therefore has the same flexibility as a passive meter. Polarity switching is accordingly not required.

The provision of a 1V FSD range for the DC voltage function is something of a "bonus," as the majority of conventional VTVMs have a maximum sensitivity of 3V FSD. This range has been made possible by the increased sensitivity of the JFET meter amplifier, and should prove very useful for making measurements in low-voltage semiconductor circuitry and similar situations.

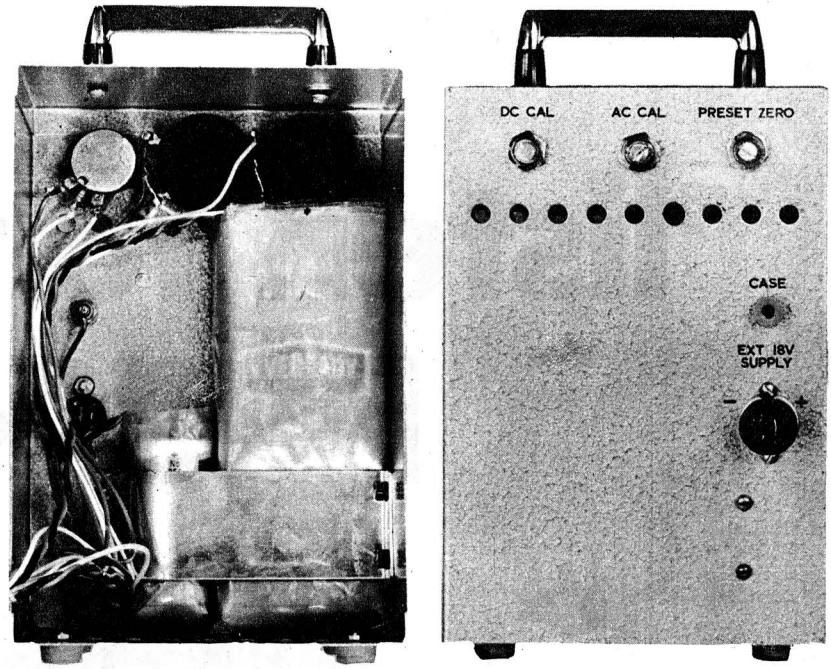
An equivalent range has not been provided for the AC voltage measuring function, for the reason that linearity problems are created at low AC input voltage levels by the forward conduction characteristic of the silicon diode used in place of the usual diode valve as the peak rectifier. It has been found possible to obtain an order of linearity adequate for ranges down to 3V RMS full scale, using a non-linear shunting technique, but this technique would not really be capable of providing a worthwhile 1V range. In fact, to provide AC measurement ranges of higher sensitivity than 3V with a solid-state instrument it is necessary either to employ an active rectifier system, or to employ a rectifier preamplifier system as used in AC millivoltmeters.

The non-linear shunt used to linearise the 3V AC range consists of a 10M resistor in series with three low-voltage silicon diodes, type BA100 or similar, and connected across the main voltage attenuator divider string. In effect, the shunt varies the sensitivity of the DC metering amplifier in a manner which compensates for the nonlinearity of the main rectifier diode.

Note that the non-linear shunt is connected permanently to the rectifier output, and therefore remains operative on all AC ranges. For input voltages of higher than about 3V RMS it acts purely as a 10M resistor, and the circuitry has been arranged to allow for the slight shunting effect involved.

In the interests of extreme economy the resistor and diodes of the shunt may simply be omitted, but this is not recommended because both the linearity and the calibration of the 3V AC range will suffer as a result. If the shunt is omitted, the AC calibration of the instrument should be set up using a range other than the 3V range, otherwise the accuracy on all AC ranges will suffer.

As is the case with conventional VTVMs, the highest (1KV) voltage measuring ranges are best regarded as "over-range" facilities rather than full measuring ranges, because although the instrument is suitably calibrated for measurements on these ranges it is doubtful whether the components associated with the input circuitry would be capable of withstanding the potentials corresponding to full-scale deflection. This particularly applies to the 1KV AC range, where the peak voltage present at the input of the instrument for FSD would be almost 1500 volts; at this figure most input connectors and rotary switches will tend to suffer damage, as one might imagine.



Two views of the rear of the meter case, one showing the interior and the other the exterior. Although the preset controls are shown mounted on the case rear, a better plan would be to mount them on a small sub-panel inside the case (see text).

In fact, it is best to use the 1KV ranges only to perform measurements up to about 600V, employing a suitable high-voltage divider probe if the instrument is to be used to measure voltages higher than this figure. A suitable probe for this purpose may be described in a following article.

The silicon diode of the AC peak rectifier should ideally be capable of withstanding at least the peak value of 1000V RMS, i.e., 1414V. However, in view of the probable damage which would be sustained by the input connectors, switches and other components in the event of this voltage being applied, and also in view of the relative scarcity and high cost of diodes having a rated P.I.V. of higher than 1000V, it seems almost fatuous to specify a diode with the required 1500V+ rating.

Instead we are simply recommending that the constructor should use a diode of at least 1000V rating; suitable types are shown in the circuit. Of the types shown it may be noted that the A14P is a General Electric type featuring voltage transient overload protection, and should accordingly offer increased reliability.

It should also, perhaps, be noted that a surge-limiting resistor (220 ohms) has been included in the peak rectifier circuit to protect the diode from current transient overload. While not required in a VTVM because of the relatively high internal resistance —and ruggedness — of a diode valve, this resistor is worthwhile "insurance" when a semiconductor diode is used.

The peak rectifier reservoir capacitor (.033uF) is in a more-or-less parallel situation to that of the diode; ideally it should have a voltage rating well above 1500V, to allow for any DC superimposed upon the AC voltage being measured. However the specified rating of 1500V should be sufficient to cope with most situations, and should be adequate if the precautions noted earlier are observed.

The resistance measuring ranges are exactly the same as those in most VTVMs, both in circuitry and in operation. A standard 1.5V Leclanche "D-type" dry cell is used, as noted earlier, although other types such as the manganese-alkaline cell or nickel-cadmium cell might prove more suitable in some circumstances. We may be able to pursue such matters further in a later article.

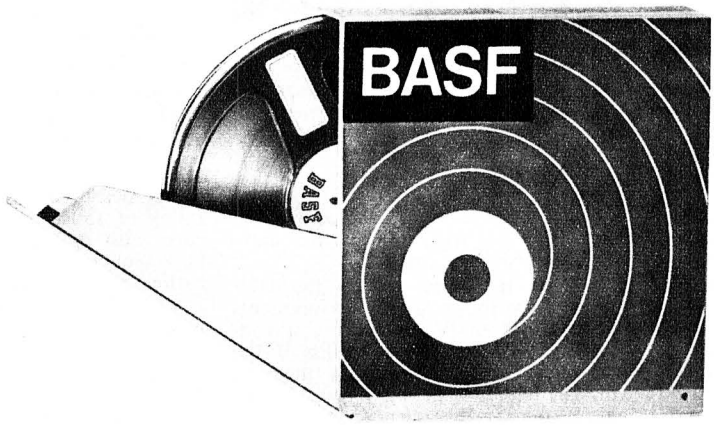
The switching associated with the meter movement is quite straightforward, and its operation should be almost self-evident. The function switch S1(d) is arranged to apply a short-circuit across the movement in the "off" position, which will subject it to heavy electrical damping and reduce the risk of mechanical damage during transit.

To allow the meter to be used to check the condition of the internal 18V battery, a microswitch button is used to disconnect the movement from the DC amplifier and connect it across the battery via a multiplier which converts it into a 0-20V passive voltmeter. As the battery may be tested when the instrument is either "on" or "off," it is therefore possible to observe the battery on and off-load.

The "battery test" may also be used to check the voltage fed to the instrument when it is operated from an external power supply in place of the internal battery.

Provision has been made for connection to the instrument of both active and passive AC probes, by means of a 5-pin "DIN" socket on the front panel. An RC filter provides decoupling for the DC supply available at the probe socket, to simplify power supply problems and to ensure stability with active probes.

listen to this page.



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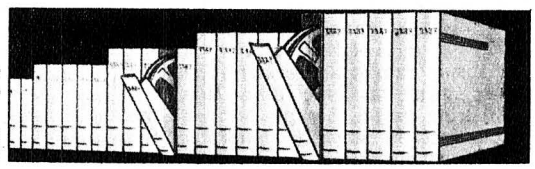


It may be noted that the circuitry of the instrument is fully insulated from its metal case, so that the latter may be either earthed, left unconnected or tied to any appropriate point to ensure both reading accuracy and operator safety for "floating" measurements. The probe socket body is connected to the case, so that by arranging that the cable braid and casing of any probes used are connected to the instrument case via the socket, the case-probe system will function as an electrostatic "guard" system. Naturally this will involve insulation of both the "active" and "return" probe input connections from the probe casing, and this is easily achieved.

As may be seen from the photographs, the physical form of the new instrument closely resembles that of many VTVMs. In fact the prototype instrument was built in a modified case intended for our "1966 VTVM", and employs an identical meter movement. Almost the only differences in external appearance are the additional "battery test" button, an additional position on the range switch, and the use of a different type of probe socket.

The main external differences are actually at the rear of the case, with the three preset controls along the top and the "case" connector and external supply socket at centre right. A final difference is the possibly conspicuous absence of a mains cord!

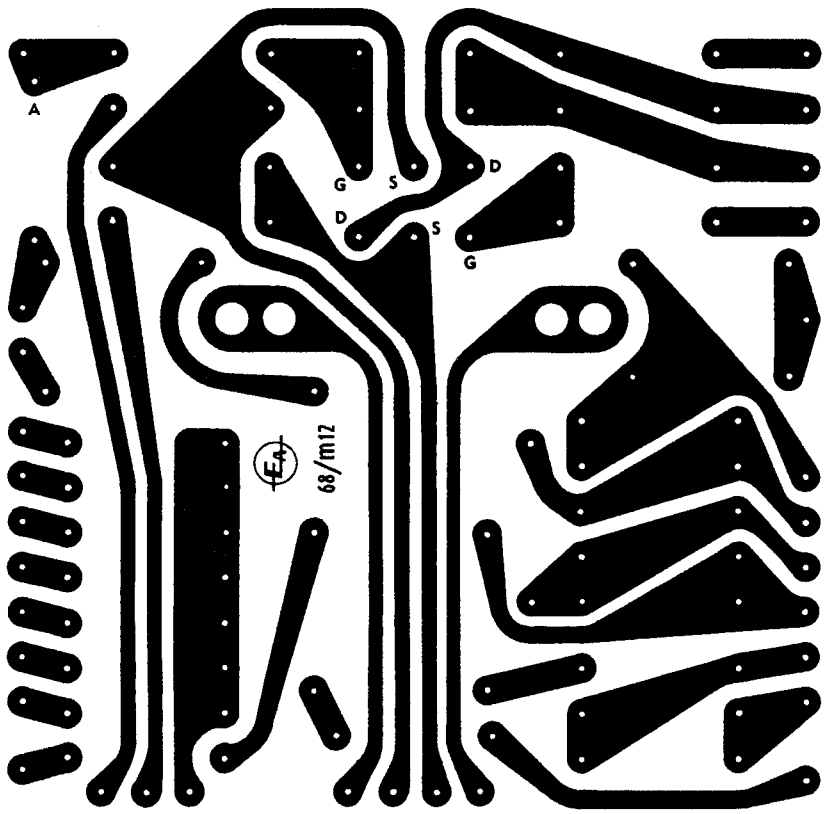
Incidentally it may be noted that the preset controls of the prototype instrument are mounted directly on the rear of the case. This has the disadvantage that the settings may easily be altered by accidental contact, and accordingly it is recommended that constructors do not mount the controls in this fashion. A far better plan would be to mount them on a small sub-panel bolted just inside the case; this will prevent the settings from being disturbed, while still allowing convenient screwdriver adjustment.

Higher-quality preset pots are recommended for these controls, very suitable types being the "RM" series marketed by I.R.H. Components Pty. Ltd. This firm is also able to supply miniature microswitch buttons very suitable for the "battery test" function, the appropriate code number being SB-2061.

Inside the case, most of the minor components are supported by a small printed wiring board which connects to, and is supported by the meter connection studs. We have prepared a wiring diagram showing the position of the components on the board, and the destination of each of the leads connecting to it; as the remainder of the wiring is fairly straightforward, assembly of the instrument should therefore present few problems.

Note that two sets of meter mounting holes are provided on the board, to suit most commonly available movements. Also that the two MPF105 transistors are arranged to be close together with their "flats" adjacent, allowing them to be clamped together by a small strip of sheet copper or brass. This will ensure that the two always remain at much the same temperature, and will reduce any possible drift to a minimum.

Those resistors in the circuit which have non-preferred values are in fact made up using two or more units of standard value. In one case this has been done to protect individual resistors from excessive applied voltage; however, in the remaining instances, multiple units are used purely to obtain the required special values.



The printed wiring board pattern for the new meter, reproduced slightly smaller than full size (actual size 4½ inches square). Note the two pairs of meter stud holes, intended to match the most common meter styles.

The 19.9K meter multiplier used for battery checking is made up from two in parallel, one a 22K 5 per cent type and the other a 220K whose tolerance is not critical.

The remaining non-standard values are in the input voltage attenuator, and these are made up as follows: The 7.5M value consists of three in parallel, with values 3.3M, 2.7M and 1.5M. The 2.35M value consists of two 4.7M units in parallel, while the 750K value consists of a 680K-68K series combination. The lower values are all made up from parallel combinations of preferred values double the specified value:2 x 470K giving 235K, 2 x 150K giving 75K, 2 x 47K giving 23.5K, and 2 x 22K to give 11K.

The type of resistor used in the input attenuator and ohms reference circuits will depend largely upon the extent to which the instrument is to be

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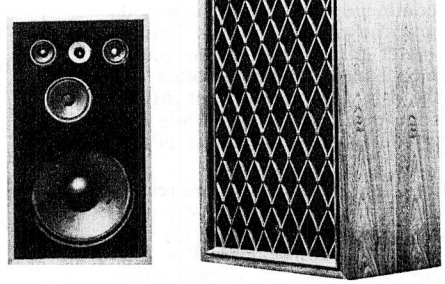

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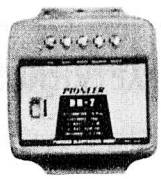

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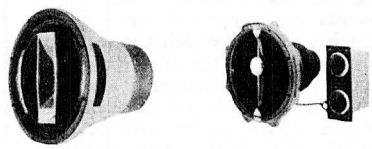

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taken seriously, and also upon the allowable cost. Ideally the resistors concerned should all be precision high-stability types, but these are admittedly quite costly and would scarcely be justified except where the instrument is intended for serious development laboratory or field work.

A compromise would be to use high-stability types of wider tolerance, such as cracked-carbon components with 2 per cent tolerance. This approach will probably give the instrument an overall accuracy and reliability adequate for most general applications. In fact this was the approach adopted with the prototype instrument shown in the photographs.

If the outlay involved with the foregoing approach is still regarded as excessive and inappropriate, there is no reason why the constructor should not use standard carbon composition resistors of 5 or 10 per cent tolerance, perhaps selecting the values closest to those required with the aid of a resistance bridge. With care this approach can still give adequate overall accuracy for servicing and amateur work, although the long-term reliability may leave something to be desired.

The two batteries which are included in the instrument are clamped firmly in place in the rear lower right of the case by a small bracket of sheet aluminium. To ensure that there is no risk of breakdown between the battery electrodes and the instrument case, both batteries are wrapped tightly with a few layers of polythene sheeting before being clamped into position.

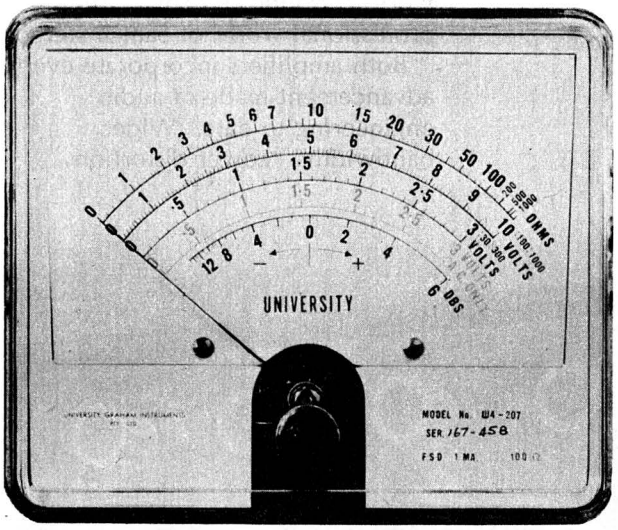
When the instrument is completed, the metering amplifier must be balanced before calibration can be performed, and this may be done in the following manner.

The first step is to ensure that the meter movement itself is correctly adjusted to indicate "zero" when no power is applied. If there is any residual reading, this should be removed using the usual screwdriver adjustment. The instrument may then be turned on, to the "DC" function and the 3V range, with no input applied and the front-panel zero control set to mid-position. The input connectors may be either left open or shorted together.

At this point there will most probably be a significant meter reading, indicating that the circuit is unbalanced and the two JFETs are drawing unequal currents. There is a 50 per cent chance that this state of affairs may be corrected simply by adjustment of the "preset zero" pot at the rear of the case, the pot simply being turned until the meter reading falls to zero.

If it proves impossible to reduce the meter reading to zero, this will be because the device in the T1 position is actually that with the higher Idss. In this case it will be necessary simply to reverse the position of the two devices, whereupon the problem should disappear.

With the metering amplifier balanced, the remaining set-up operation is to perform DC and AC calibration. This may be done with the instrument set to any of the appropriate ranges which proves convenient, as single calibration controls are used for the two functions. The calibration operation will normally involve a suitable source of variable voltage (preferably regulated), together with a voltmeter of known calibration against which the new instrument can be compared.



The meter movement used in the new instrument is identical with that used in our previous VTVMs.

The ohms function does not require calibration, as the action of producing full-scale deflection with the "ohms adjust" control (with open-circuit input) will automatically ensure calibration except when the 1.5V cell has deteriorated to the point where its internal resistance has become significant relative to the reference resistors selected by S2(b). Before this point is reached the battery should normally have been replaced; we have deliberately restricted the sensitivity available on the ohms function, by means of the 330 ohm resistor in series with the "ohms adjust" pot, in an effort to ensure that this is the case.

It was noted earlier that the service life of the main battery used in the instrument should be in excess of 200 hours; with careful use this should correspond to a considerable period of time. One factor which should aid in obtaining economical operation is the virtually "instant warm-up" of the instrument, which will enable it to be turned off between readings in many situations.

The battery should normally be replaced when its voltage, as read under load using the "battery test" button, has fallen to about 15V — corresponding to approximately 75 per cent of full scale. With supply voltages lower than 15V the accuracy and linearity of the instrument will be impaired. ■

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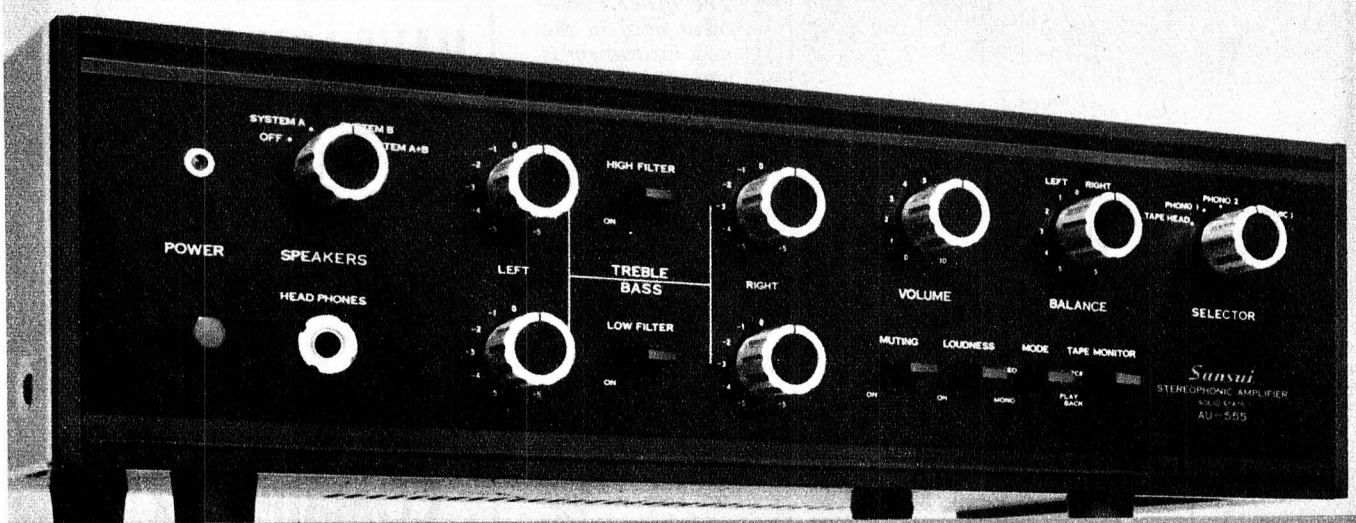

AU-555 SPECIFICATIONS

Main Amplifier Section
Music Power (IHF): 60 watts ±1db at 4Ω
Continuous Power: 25/25 watts ±1db at 4Ω
Harmonic Distortion: less than 0.5% at rated output
Power Bandwidth (IHF): 20 to 30,000Hz at 8Ω
IM Distortion (60Hz : 7,000Hz): less than 0.8%
Hum and Noise (IHF): better than 100db
Damping Factor: 12 and 45 at 8Ω
Pre-Amplifier Section
Output: 1V
Hum and Noise (IHF):
  Phono 1 and 2: 80db
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  Aux 2: 140mV
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Music Power (IHF): 46 watts ±1db at 8Ω
Continuous Power: 18/18 watts ±1db at 8Ω
Harmonic Distortion: less than 0.8%
IM Distortion (60Hz: 7,000Hz): less than 0.8%
Power Bandwidth (IHF): 20 to 20,000Hz at 8Ω
Hum and Noise (IHF): better than 80db
Damping Factor: 20 at 8Ω

Input Sensitivity:
Phono 1: 2mV
Phono 2: 2mV
Tape Head (19cm/s): 1.5mV
Aux 1: 150mV
Aux 2: 150mV
Tape Monitor: 150mV
Power Voltage: 100, 117, 220, 240V; 50-60Hz
Power Consumption: 100VA max.
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Forum

Australia should have "novice" licences

A correspondent this month points out a most frustrating anomaly to do with amateur radio. Australian amateurs are keen to see Beginners' or "novice" licences, but the Government has so far failed to issue them. The British Government, on the other hand, plans to introduce Beginners' licences but a body of amateur opinion in England is solidly against them!

Conducted by the Editor

In the following letter, the writer severely criticises the attitude of British Amateurs who think this way and sees it as an extension of an alleged lack of enterprise on the part of the R.S.G.B. in recruiting young people to their ranks:

Dear Sir,

"I have noted with great interest in recent issues preliminary information regarding the proposed Beginners' licences being introduced this year by the British G.P.O. Having started and administered our Wireless Institute's Youth Radio Scheme for a number of years I can envisage what a boon such a licensing system would be here in Australia; yet, from the tone of Mr Clarricoat's editorial in 'Region I Bulletin,' it appears that the Radio Society of Great Britain is greatly perturbed at this unilateral action by the G.P.O.

"Our Y.R.S. could cope with such a move without any difficulty whatever; we have highly qualified men administering the Scheme—both educationally and technically—and could operate a well-supervised and efficient system involving lower-level transmitting permits if given the opportunity; yet the R.S.G.B. is offered such a system and doesn't want it!

"I recall, several years ago giving up an entire school vacation and working solidly, morning, noon and midnight oil to prepare information about our Y.R.S., as there seemed to be a spark of interest in starting a somewhat similar movement in U.K. All this effort went for nought, the British Society stepped back from the brink and, consequently, is now in a position where it cannot use such an excellent offer by the G.P.O.

"Mr Clarricoat's editorial paints a most dismal picture involving the invasion of the DX bands by 'thousands of irresponsible people' with Beginners' licences. If the R.S.G.B. had a Y.R.S. operating, it could have made excellent use of well-supervised Beginner licensees whose addition to the ranks of the R.S.G.B. would provide a real 'shot in the arm' for the British amateur movement. His further statement about the emergence of large numbers of young people 'possessing all kinds of illicit transmitting equipment' merely demonstrates that young people in U.K. are in real need of guidance in the field of hobby radio. Surely the R.S.G.B. is the organisation which should be offering such guidance!

"Surely the resources of the R.S.G.B. should be sufficient for their administrators to be aware of what is happening in other parts of the world:

"The American Novice system, started in 1951, doubled the amateur population of the U.S.A.

"The U.S.S.R. operates a massive Radio Club Scheme through the Ministry for Communications and provides incentive licensing with a Beginner type transmitting at the lower level, available to school pupils as young as 12 years.

"India, Israel, Japan and South Korea are other nations where communications administrations have made provision for lower-level qualifications for young enthusiasts.

"One cannot be so naive as to believe that these moves are solely directed to building up the amateur radio movements; there must surely be some side-benefits such as developing electronics-mindedness among young citizens who will be required in increasing numbers to enter the expanding electronics and scientific fields in peacetime and form an invaluable pool of semi-trained personnel in case of war.

"While it is pleasant to look back on 50 years of amateur radio under present licensing conditions, it cannot be denied that the world of 1968 is a very different place from that of 1918. Not even amateur radio can live in the past and it behoves us as amateurs and as amateur societies to move with the times. If the times warrant variations in licensing conditions, then by all means let us be sufficiently flexible in our thinking to "get with it." If the R.S.G.B. fears an uncontrolled invasion, it should take smart action to present a workable scheme that will preserve as many of the former privileges as possible and, at the same time, provide for the extension of amateur operating to a wider segment of the community.

"Mr Clarricoat points out, quite correctly, that with shorter working hours, young people have greater leisure periods. This places on the amateur movement an increasing obligation to recruit as many of these junior citizens as we can, so that they may engage in worthwhile hobby activities instead of being diverted by the many distractions which beset them. The amateur societies should try to develop opportunities for these young people to become aware of what amateur radio has to offer and to demonstrate that it has greater ability to interest and absorb leisure time gainfully than have some of the other undesirable activities which so blatantly befoul the British scene.

"If this necessitates knocking some of our sacred cows on the head, then let them be knocked on the head and fast! If this involves the R.S.G.B. in some extra thought and effort and planning, then go to it, Mr Clarricoat. Give us a similar opportunity Mr Hulme, and we'll show the R.S.G.B. what can be done!"

Yours very furiously,
Rex Black (VK2YA).

In case there should be any tendency for readers to confuse the question of novice licences with that

of the "Citizens' band," mentioned in a recent editorial, it may be as well to point out that they are quite unconnected.

The purpose of a novice licence would be to make it easier for anyone so inclined to become involved in amateur radio, using frequency bands specifically set aside for use by amateurs. The holders of such licences would be subject to the regulations and the disciplines which are relevant to these bands and, without prejudicing other services, they could pursue their basic interest in transmission and reception for its own sake.

This is a very different situation from one in which frequencies set aside for communication are swamped illegally by people who merely want to "yak."

Music Station

Changing the subject, the letter on this page enters a plea for a high quality music station to serve the Melbourne area.

"Why Melbourne?" one might ask. What about listeners in Sydney and Brisbane and Adelaide . . . and other major centres of population?

Well, if a group of people in Melbourne have shown enough interest and initiative to attend meetings and get the ball rolling, good luck to them. Would-be listeners in other areas could do likewise if they feel strongly enough about it.

Whether the Melbourne group is likely to accomplish anything is another matter but battles are never won by giving in before they start.

To be horribly practical, the cause for high quality music on radio has never seemed to be at a lower ebb than it is at present and a recent discussion night at the Sydney I.R.E.E. did nothing to support the opposite view. Despite an effort by the panel (of which I happened to be moderator) to provoke retort and discussion, there was little evidence of any real concern to fight for better things for radio, in terms either of improved technical or improved musical standards.

So while records sell in vast numbers and stereo players spread from single cabinets to multiple units, radio subsides even further into the role of the talking juke-box.

And from the U.S.A., in the latest issue of "High Fidelity Magazine" comes this lament:

WHATEVER HAPPENED TO FM CLASSICAL MUSIC,
or
HAS SUCCESS SPOILED FM?

"FM, once accused of being nothing more than a classical juke-box, is fast losing its identification with the classics. New York, which formerly had more than a dozen commercial stations broadcasting classical music on the FM band, is now down to five, Washington, D.C., where the FM band once was occupied almost entirely by so-called good music, is down to one such station; and in Philadelphia, one of the earliest of the classical music stations, WFIL-FM, ditched the last of its classical programs in July.

"What's replaced classical music has been a mixture of rock, 'easy listening,' top pops, and talk. And the reasons can be traced to two developments that otherwise have helped FM: the FCC rule requiring big-city FM stations to program separately from their AM affiliates and a startling growth in the size of the FM audience. The first development has forced many former 'free-riding' FM stations to have to pay their own way. The second has diluted (or expanded, if you will) the taste of those 'out there" who eventually have to pay."

Perhaps the real explanation of all this is that records are just too plentiful, too accessible, too inexpensive and too good for listeners to really look beyond them. If radio doesn't supply the music they want, be it FM or AM, they don't stand up and fight en masse. They simply flick the switch to "Record player" and abandon the airwaves to those who still like what they hear on them.

The Musical Broadcasting Society of Victoria has a king-sized problem to cope with, but good luck to it!

Music Station sought for Melbourne

Dear Sir,

Eighteen months ago you published in your Forum columns (April, 1967), a letter which started a chain of events, culminating in the formation of the "Music Broadcasting Society of Victoria," an organisation for the promotion of serious music broadcasting in Melbourne. The letter was from Mr B. E. Cabena, now Chairman of the Society, and it drew attention to the lack in Australia of any broadcasting organisation which was prepared to cater adequately for the substantial minority audience for serious (viz. "classical") music.

In June of this year, an Interim Committee was formed to guide the incipient society through its formative stages, and on 25th September, the "Music Broadcasting Society of Victoria" came officially into being with a membership of some 450 people. Since this organisation may be said to have had its beginnings in your columns, we felt that you might be interested to publish some of its objectives in Forum.

The M.B.S.V. aims to improve the situation for the broadcasting of serious music by:

(a) Demonstrating to the authorities that there is a need in a mature community for a service such as is provided in the U.K. by the B.B.C. Third Program;

(b) building up a large membership in order to influence the authorities to allocate the Society a broadcasting frequency in a generally accessible region of the broadcast spectrum;

(c) establishing in Melbourne a listener-owned co-operative station for the broadcasting of serious music, broadly on the lines of overseas examples, as a first approach to meeting the need that exists;

(d) persuading the authorities that the broadcasting of serious music deserves higher fidelity in transmission, and the use of clear area in the frequency spectrum.

We have in mind petitioning for frequency allocation in the 1.8KHz region, in the manner of the University of New South Wales station, which we feel to be a more realisable opening gambit than joining the frustrated clamour for a service in FM. Your own comments on the FM scene (particularly the January, 1967 Editorial, and the correspondence which flowed from it) view the difficulties of this action very realistically, in our opinion. However, our fourth aim indicates that we regard FM as a highly desirable goal for those advocating an increase of high quality broadcast time, and we support in principle its re-introduction.

Membership of the Society is by payment of an annual subscription of fifty cents, and to realise our aims we obviously need the effective support of every music lover. We think that a membership of 20,000 is not an unreasonable goal, considering the size of the musically aware section of the community in Victoria. We already have members in centres up to 100 miles from Melbourne, where the problem of the reception of serious music programs is particularly acute. But, to convince the authorities of a need, we must have the support of a very substantial number of people.

The Society will have achieved its primary purpose when a licence to broadcast has been granted. Details of the operation of the broadcasting station which would ensue must obviously be matters for careful deliberation in the future. However, we propose that this should be run on a subscriber-financed co-operative basis, for which there are several good models in the United States.

On information available to us, it seems reasonable to suggest that this could be established and maintained on the basis of 5,000 subscribers at the rate of $8 annually. We would naturally expect to draw this amount of support from among the membership of the present society, but membership of the M.B.S.V. does not commit anyone to any further financial outlay in the future.

I would reiterate that such a scheme, to have any chance of success must have the support of the largest possible number of people. We hope that your readers will join us in our effort to provide an adequate service of serious music to listeners in Melbourne.

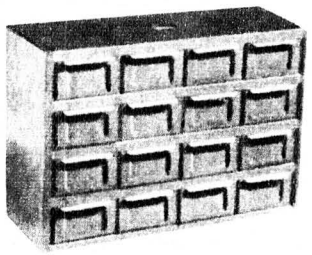
T. D. JARVIE, Secretary, Music Broadcasting Society of Victoria, 146B Cotham Road, Kew, 3101.

CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in, containing 16 drawers, each measuring 6⅝ x 3¾in x 2⅛in.

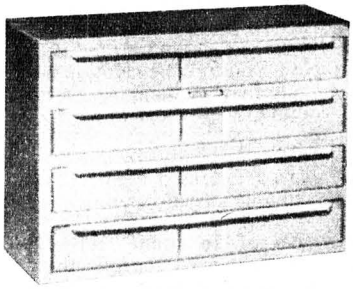
- TYPE C.D.1. With 16 undivided drawers, **$7.00.**
- TYPE C.D.2. With 16 triple compartment drawers, **$8.00.**
- TYPE C.D.3. With 8 triple compartment drawers, and 8 undivided drawers, **$8.00.**

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.



CHEST OF DRAWERS TYPE C.D.4.

A 17⅛in x 6¾in x 11⅞in Galvanised Chest containing 4 full-length drawers each measuring 15¾in x 6⅜in x 2½in. Finished in blue hammertone stoving enamel. **$7.00.**



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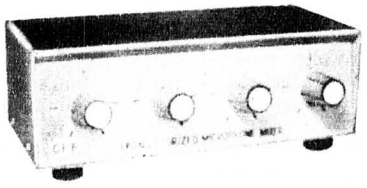

All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

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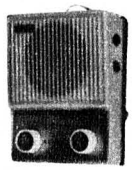

This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

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40.S	5⁄16in	0.618in	¼in	5/16in	$2.17
48.S	⅜in	0.742in	⅜in	5/16in	$2.80
56.S	7⁄16in	0.884in	½in	⅜in	$3.80
64.S	1in	1.008in	—	⅜in	$4.10
72.S	1⅛in	1.133in	¾in	⅜in	$4.53
76.S	1/3/16in	1.172in	—	⅜in	$4.53
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88.S	1⅜in	1.382in	1in	7/16in	$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

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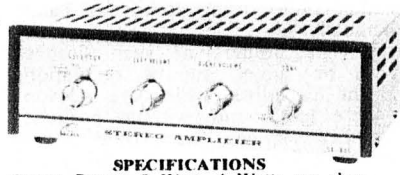
8 WATT STEREO AMPLIFIER MODEL SA-80S OPERATING MANUAL

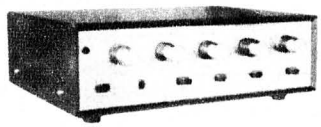


SPECIFICATIONS

Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps, plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

Price $35.00

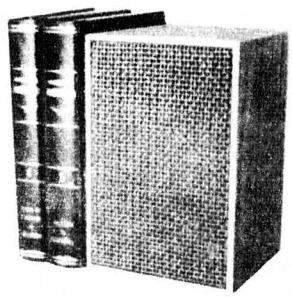
"PALACE" SOLID STATE STEREO AMPLIFIER Model AM-320



Power Output: 16W (8W per channel).
Frequency Response: 80-10.000 cps plus or minus 1dB 1W; 50-20.000 cps plus or minus 2dB 1W.
Harmonic Distortion: Less than 2% at 3W; less than 4% at 5W; less than 4.5% at 8W.
Tone Control: Bass plus or minus 10dB at 50 cps. Treble plus or minus 10dB at 10.000 cps.
Loudness Control: Plus 6dB at 50 cps; plus 4dB at 10.000 cps.
Input: Tape head 3.5mV; Mag. 3.5mV; Cer. 100mV; Tun., Aux. 150mV.
S/N Ratio: Minus 45dB.
Transistor complement: 2SB347 x 2, 2SB345 x 8, 2SB481 x 4.
Power Supply: 117V AC 50/60 cps.
Dimensions: 10¾in (W) x 3½in (H) x 8¼in (D).
AM-V320 Upright.

Price $92.00

BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S



Speaker: 4in, 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5⅞ (D).
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. . . the "Programmable" UJT

Despite its somewhat esoteric title, the "programmable unijunction transistor" is not a unijunction transistor at all; in fact it is simply a complementary thyristor, and as such shares the same PNPN structure and "modus operandi" of the normal thyristor or SCR (silicon controlled rectifier). The only basic difference between the two is that whereas the normal thyristor is provided with a cathode-gate electrode for conduction triggering, the "PUT" is in contrast provided with an anode-gate.

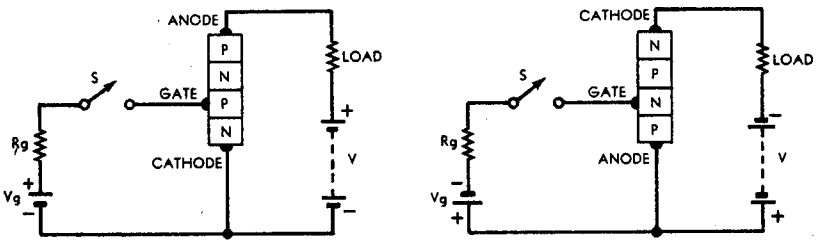
It may be remembered that the PNPN structure used in thyristor and four-layer diode devices has two stable conduction states: the "off" state, in which only leakage current flows across the central junction, and the "on" or conduction state in which the current through the device is determined almost completely by the external circuit. Switchover of the structure from the "off" to the "on" state may be initiated in a variety of ways, all of which depend upon two general principles. The first of these is that there is a characteristic dependence, in silicon devices, of current gain upon current level; the second is that the PNPN structure is capable of internal amplification and regeneration.

The triggering method commonly employed with the normal thyristor is illustrated in figure 1 (a). With switch S open initially, only leakage current flows in the load because the central P-N junction is reverse biased. At this current level the internal amplification of the PNPN structure is low, and insufficient to produce regeneration. However, if the switch is closed, a forward bias is applied to the lower or "cathode" junction. Current then flows through this junction, mainly in the form of electrons passing from cathode layer to gate layer.

As minority carriers in the gate layer, the injected electrons tend to find themselves within the depletion layer associated with the reverse-biased central junction, and accordingly swept across the junction and toward the anode. The current through the cathode-anode circuit therefore rises, and with it the internal amplification of the device. This action is regenerative, the increased amplification producing a further increase in current, and vice-versa; as a result the structure switches rapidly to its heavily conducting "on" state.

It may be seen that, if the PNPN structure is visualised as consisting effectively of a PNP-NPN transistor pair sharing a common collector-base junction, gate current switch-on of the normal thyristor is initiated by applying forward bias to the "base" of the internal NPN transistor. However, since the PNPN structure is a symmetrical one, it follows that it would be equally feasible to initiate switch-on by the application of forward bias to the "base" of the PNP element—namely, the upper N-type layer.

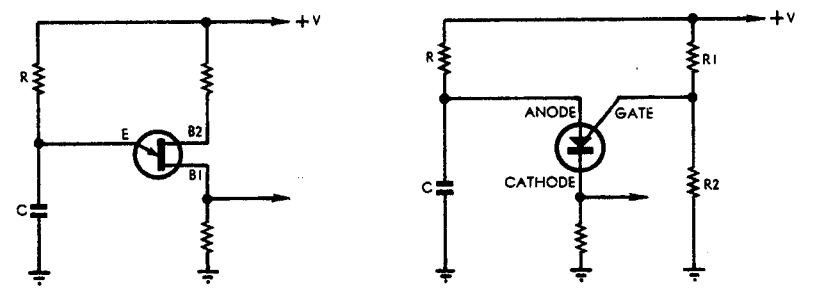
In fact this is precisely what is done with the complementary thyristor and the programmable unijunction; in place of the "cathode gate" connection of the normal thyristor, these devices are provided with an "anode gate" connection. Functionally this has no effect upon device operation, and as illustrated in figure 1(b) operation of the complementary devices as a triggered switch simply involves reversal of the supply voltages.



(a) NORMAL THYRISTOR OR "SCR"

(b) PROGRAMMABLE UNIJUNCTION (COMPLEMENTARY THYRISTOR)

Figure 1



(a) NORMAL UNIJUNCTION

(b) "PROGRAMMABLE UNIJUNCTION"

Figure 2

Naturally enough, complementary thyristors can be used to perform all the functions performed by normal thyristors—controlled power rectification, power switching and power logic. However, it has recently been realised that low-power devices of both types may be arranged quite easily to function as a "programmable" unijunction. In other words, they may be arranged to behave like unijunctions in which the major operating parameters are not internally fixed, but externally adjustable.

When used in this fashion the "normal" thyristor becomes equivalent to a "complementary" unijunction (i.e., one with a P-type base), while the "complementary" thyristor becomes equivalent to a "normal" unijunction. Hence the tendency to call low-power complementary thyristors "programmable unijunctions," even though low-power normal thyristors are equally capable of operation in this fashion (with polarities reversed).

Figure 2 shows the usual schematic symbol for a complementary thyristor, and also illustrates the use of the device as a programmable unijunction relaxation oscillator or timer.

In (a) is shown a normal unijunction relaxation oscillator, with an R-C charging circuit connected to the emitter electrode, base-2 connected to the positive supply rail via a temperature compensation resistor, and base-1 connected to earth via an output load. It may be recalled that when capacitor C charges to a voltage slightly above that determined by the interbase divider within the device, the emitter-base junction becomes forward biased and conducts to discharge C through the output load. The cycle of events is repetitive and produces a sawtooth waveform at the emitter together with a series of positive pulses at B1.

With the normal unijunction the emitter voltage at which the device conducts is more-or-less a fixed proportion of the supply voltage. It is determined almost completely by the internal divider action or "intrinsic standoff ratio" of the device, and may be altered only slightly by variation of the resistance in series with B2. Also relatively invariable are the emitter current Ip at which the device switches on, and the holding current Iv which determines the point at which the device turns off again after discharging C. Both these parameters are also fixed by the device characteristics.

The circuit of figure 2(b) operates in a very similar fashion to that just described. With the gate electrode held at a positive voltage determined by R1 and R2, the device is prevented from conduction until the capacitor C charges via R to a point where the anode electrode is sufficiently positive for the gate-anode junction to be forward biased; the device then switches on, discharging C into the cathode load. Again the cycle of events is repetitive, and produces very similar waveforms to that of figure 2(a).

However, whereas in the former cir-

(Continued on page 63)

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122	.075"	34 way	17.9" x 3.75"	.040"	$1.86 each

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245/2506	.1"	24 way	3.75" x 3.75"	.052"	$1.13 each
281/271	.106"	22 way	3.7" x 3.591"	.052"	$1.13 each
304	.075"	22 way	3.7" x 2.5"	.040"	$1.04. each

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442/4505	.15"	24 way	17" x 3.75"	.052"	$1.00 each
522	.1"	34 way	17.9" x 3.75"	.040"	$1.16 each

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In simple terms, what is meant by—

KLYSTRON OSCILLATORS, KLYSTRON AMPLIFIERS*

Nearly 30 years ago, a group of men working in a small, meagerly equipped laboratory on the Stanford University, Palo Alto, campus, invented a microwave tube which they called the klystron. The development was the work of Russell and Sigurd Varian and William Hansen and it was completed just in time to make possible many types of World War II radar. Today the klystron is still at work in the defence systems of the West. It powers the radar which probes the polar regions for oncoming ballistic missiles, the communications lines of NATO and of the U.S. Armed Forces all over the world. For nearly all U.S. Missile programs, there are klystrons in the tracking and guidance systems. Varian has for many years been the leading producer of klystrons and is now a world leader in the development, promising new and useful applications for tomorrow.

There are two general types of klystrons—those generating microwaves which are called oscillators, and those that amplify microwaves (making the oscillations larger) and which are called amplifiers. In the following discussion, we shall show how both types of klystrons operate, starting with the amplifier.

The two-cavity klystron may be used as either an amplifier or an oscillator, but here we are concerned with its function as an amplifier.

In operation, the filament is heated by an electric current and it, in turn, heats up the cathode. The heat causes the cathode to emit those tiny particles of electricity know as electrons (shown in Diagram 1 as dots).

The electrons are negatively charged, and are pulled toward the opposite end of the klystron by positive charges on the two cavity resonators, the drift tube, and the collector.

The microwaves to be amplified are sent to the first cavity resonator (or "buncher") where they interact with the electrons. As a result of the interaction, some electrons are speeded up and some are slowed down. As the electrons move at different speeds on their trip from cathode to collector, the faster ones catch up with the slower ones in the drift tube and bunches of electrons are formed. This bunching is always the greatest at the same place in the drift tube, and so here is placed the second cavity resonator (or "catcher").

The bunches of electrons give up energy to the catcher by exciting microwaves in the catcher. The oscillations of these microwaves are stronger than the oscillations of the microwaves in the buncher; thus amplification has taken place.

The amplified microwaves are removed from the catcher and sent to the place where they are to be used. The electrons are caught by the collector, and return toward the cathode through an external circuit.

To illustrate how a klystron generates or "creates" microwaves, we will use a reflex klystron as an example.

From Diagram 2 it can be seen that the reflex klystron differs from the klystron amplifier in that it has only one cavity, and a reflector. The initial operation is the same as with the amplifier—the cathode, heated by the filament, emits electrons which are pulled toward the cavity resonator by the positive charge on the resonator. The electrons pass through the cavity resonator where they interact with extremely weak microwaves. (These microwaves were not fed into the cavity as was the case with the amplifier; they were created by the random motion of the electrons in the cavity.) The frequency of the microwaves is determined by the size and shape of the cavity.

These weak microwaves interact with the electrons moving from the cathode to the reflector, speeding some of the electrons up, while slowing others down. The electrons travel through the resonator at different speeds toward the reflector which, in fact, they never reach. The reflector is negatively charged, as are the electrons, and so the electrons are repelled, or reflected, back into the resonator.

Because they are travelling at different speeds, the electrons bunch and by proper adjustment, the bunches enter the cavity at exactly the right time to increase the strength of the microwaves in the cavity. The electron bunches strengthen microwaves in the same way that pushing on a swing with the right rhythm (frequency) increases the size (amplitude) of the swing's oscillation. After giving a boost to the microwaves, the electrons return through an external circuit toward the cathode, and the whose process is repeated. Each time they return to the cavity they make the microwaves larger (increase their amplitude). Once the microwaves in the cavity have built up to their final value —which can be more than 1,000 times their starting value — they are taken from the cavity and sent to wherever they are to be used. The result of this process is the generation of microwaves. ◘

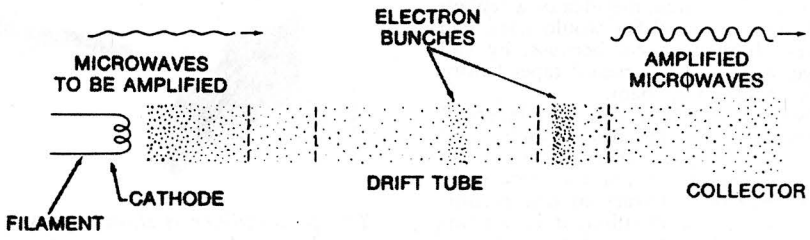

Diagram 1—Two-cavity klystron

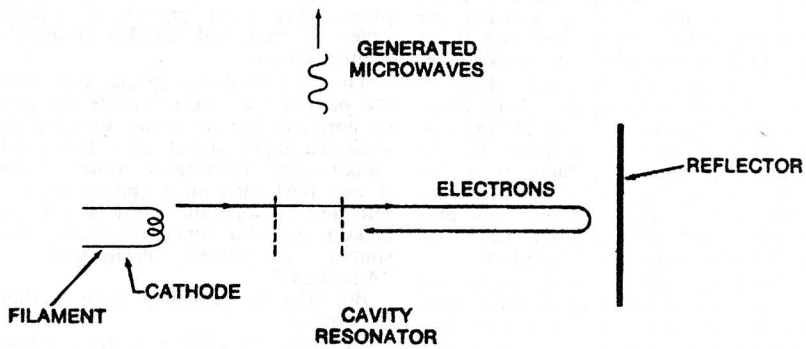

Diagram 2—Reflex klystron

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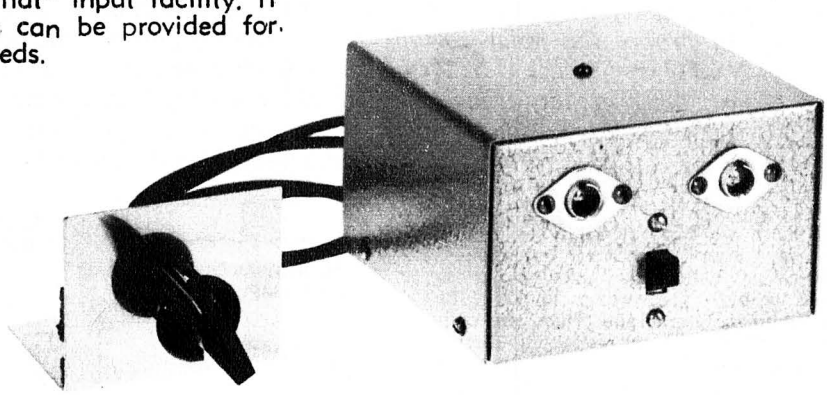
Add-on Tape Replay Preamp for Hi-Fi Systems

Here is a tape preamplifier which will acept the signal from typical stereo replay heads and provide the necessary gain and compensation to feed a stereo amplifier through the now usual 100mV "flat" input facility. If desired, adjustable compensation can be provided for three tape speeds.

by Anthony Leo



The preamplifier is shown above, housed in a small metal utility box together with the compensation-switch mounting bracket alongside.

A few years ago, the idea of a replay-only tape preamplifier would have had a very limited appeal because, by and large, people had to record tapes before they could replay them.

Nowadays, however, pre-recorded tapes are in very good supply, and those who are so inclined can build up a library of them side by side with, or instead of, a library of disc recordings. In such a situation, it is not unreasonable to envisage a tape playing deck permanently associated with the amplifier system and as carefully and irrevocably committed to reproduction as the pickup and turntable mounted alongside it.

To be sure, the fact that tapes can be made in the home is an ever-present incentive to include recording facilities in the set-up, and this leads to further incentives to provide for pick-up, radio and microphone input and to keep the whole outfit portable.

This is still the "normal" thing to do and is the philosophy behind virtually every tape recorder on the market. However, from the viewpoint of the would-be constructor, there is a big difference in cost and complexity between a straightforward playback preamplifier and the circuitry necessary for full playback/record facilities.

Another point is that, while the ability to make and play casual recordings appeals to many, it can soon lose its novelty for the person who is primarily interested in sound reproduction. Unless a great deal of care is taken, home-made recordings can be quite mediocre, and quality conscious enthusiasts are likely to develop a strong preference for selected commercial recordings, cost difference notwithstanding.

It is with such thoughts in mind that we present this tape preamplifier unit. Using silicon transistors throughout, and with the option of correct compensation for the three major tape speeds, it can be associated with confidence with almost any existing hi-fi system. Alternatively, it can take its place in a more modest playback facility, built around any odd tape deck or cassette player that may be on hand, whether mono or stereo.

In fact, the very variety of tape decks and cassette players which hobbyists have acquired over the years poses a major problem in trying to suggest circuitry to associate with them, particularly when it comes to recording. But even for playback, a preamplifier, in order to make any pretence of being universal, must take into account wide differences in head quality, head impedance and head output with, of course, the further differences occasioned by tape speed and track width. But more of that later.

As mentioned earlier, a tape replay preamplifier must provide a suitable order of gain and suitable frequency compensation.

The first needs no special comment: the preamplifier must provide the gain or amplification necessary to raise the available input signal of a few millivolts to 100 millivolts or more, so that it can feed into an amplifier channel intended to operate from a ceramic pickup, a radio tuner or some other source commonly designated as "Auxiliary."

But why is frequency compensation necessary?

In order to achieve a good signal-to-noise ratio in the overall record/playback system it is desirable to impress as much signal as practicable on the tape over the entire frequency band to be recorded. If the loudest sounds at, say, the low frequencies are to produce a certain and considerable strength of magnetic pattern on the tape, the same should also be true of the loudest signals in the middle frequency and high frequency regions.

In other words, irrespective of the frequency, the signal to be recorded should exploit as fully as possible the capacity of the tape in the magnetic sense.

Since the strength of the magnetic pattern impressed on the tape is a function of the current through the head, it is necessary to ensure that, for input signals of a given intensity, the current through the record head should achieve a similar amplitude, irrespective of the frequency involved.

This requirement is normally met, in the design of a recording amplifier, by feeding the record head from a so-called "constant current" source.

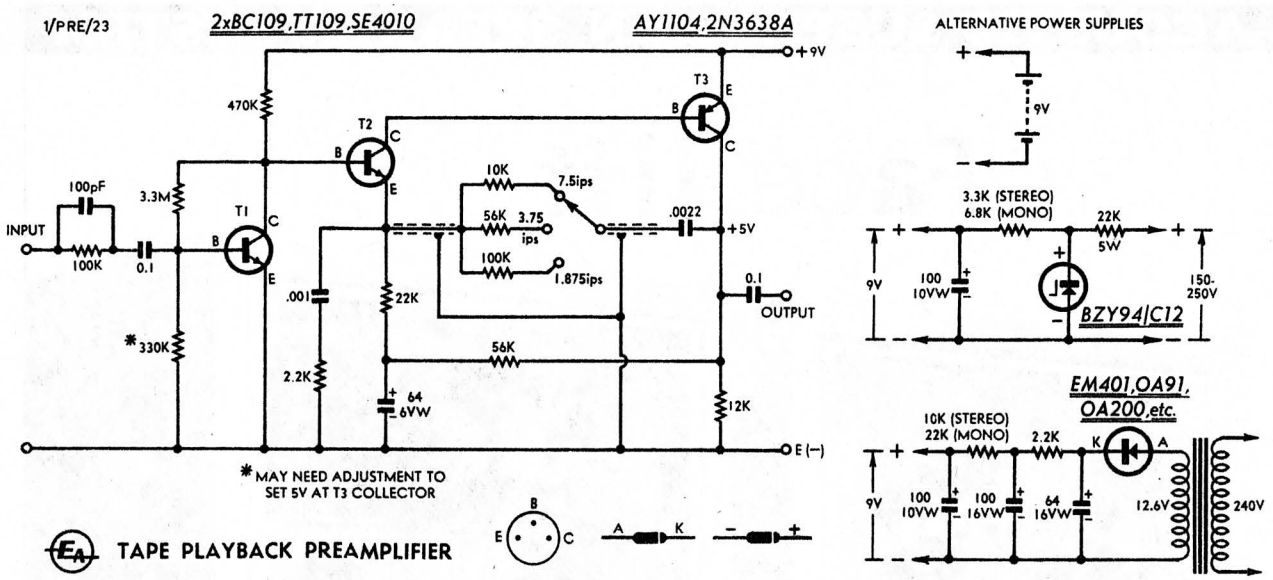
In other words, for reasons largely connected with signal-to-noise ratio, the signal impressed on a magnetic tape normally tends towards a constant amplitude characteristic—and this is the characteristic which any properly recorded tape (home-made or commercial) will present to the replay head.

When such a tape is replayed, however, it does not result in the replay-head producing a constant voltage at its output terminals. Assuming, for the moment, that we have a signal of constant level but varying frequency recorded on a tape, the voltage developed by the replay head will increase with frequency at the rate of 6dB per octave, as illustrated in the diagram of figure 2.

This is a practical example of the time-honoured law that the induced voltage across an inductor is proportional to the rate of change of the magnetic field. Obviously enough, high-frequency patterns on a moving tape must induce more rapid changes in the replay head than low-frequency patterns.

This being so, it is necessary to compensate for the rising output voltage from the head so that the output level of the amplifier will be substantially constant over a range of frequencies between F1 and F2. This is done by providing a complementary 6dB/octave slope in the playback preamplifier, as shown in figure 3. It should be readily appreciated that the product of the rising head response and the falling preamp. response will result in a flat output overall.

In an idealised system, the output voltage would increase from zero at zero frequency and continue to infinity, as shown by the dotted extensions of the slope in figure 2. But, as is usually the case, there are practical limitations which restrict the frequency response of a typical replay head to much narrower limits.



The circuit diagram of the preamplifier in a mono form is shown above, with circuitry being duplicated for stereo. Included in the diagram are alternative power supply circuits.

The principal response limitation is in the high frequency region and is dependent on the relationship between the width of the "gap" in the replay head and the wavelength of the higher frequency signals recorded on the tape. The higher the signal frequency, the shorter will be its recorded wave length at any given tape speed.

Wavelength is also a function of tape speed, and halving the speed of traverse must halve the wavelength of all signals recorded upon it. Not surprisingly, the ability of a replay head to "read" or resolve a magnetic pattern diminishes for frequencies where the recorded wavelength becomes comparable with or less than the gap width.

It follows that the potential response from any given head must be stated in terms of a particular tape speed. And, while any head will normally return better figures for higher speeds, the advantage has to be offset against the reduced tape economy—a consideration with which tape users will be quite familiar.

Other secondary factors have a bearing on tape replay head response, such as the intimacy of tape-to-head contact, progressive headwear, eddy current and hysteresis losses in the core, shunt capacitance, etc.

It may be seen from the curve in figure 2 that the high frequency response turns over quite sharply and falls to zero. The frequency which produces no output has a recorded wavelength which actually equals the width of the head gap, while the shape of the curve where it starts to turn over is determined by the approach to this situation and by the secondary factors previously mentioned. As suggested by the diagram, the upper turnover frequency F2 tends to be roughly proportional to the particular tape speed in use.

Although nothing can be done to prevent the head response ultimately falling to zero, some compensation can be applied in the area of the turnover knee to hold up the overall response of the system prior to the null. Compensation usually takes the form of a fixed amount of pre-emphasis of the recorded signal, of no more than 10dB, in the area of the knee frequency F2. This is shown as a step in the recording characteristic of figure 1.

Moderate treble pre-emphasis is considered permissible in the recording chain on the basis that, even allowing

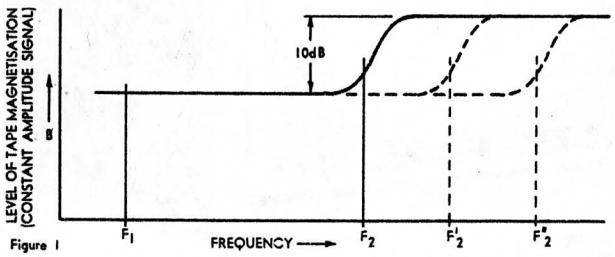


Figure 1

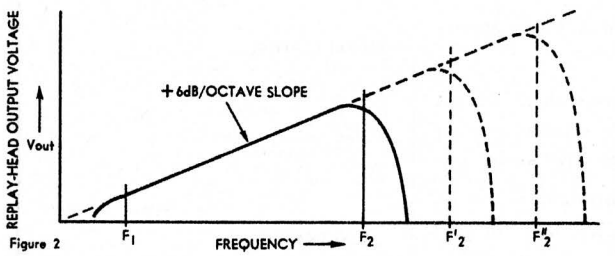


Figure 2

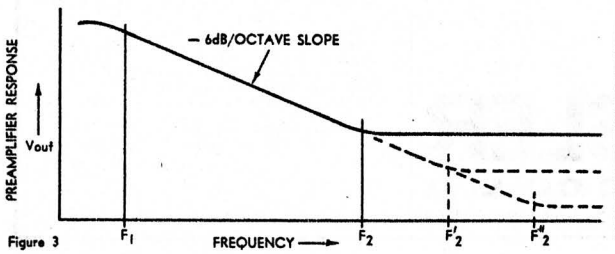
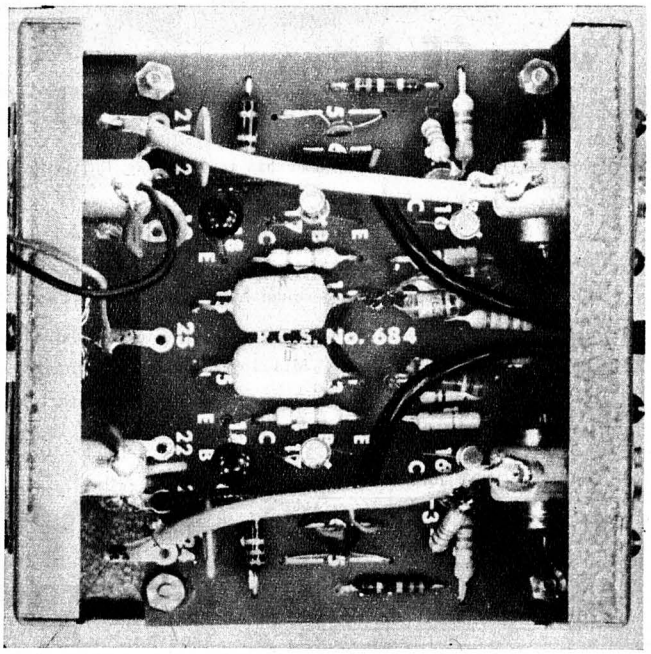


Figure 3

Shown at left are figures 1 to 3 illustrating recording characteristic, replay head response, and replay compensation characteristics. An inside photograph of the preamp is shown below.



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Power Rating: 50 watts (Music).
Impedance: 8 ohms.
Crossover Frequency: 800 Hz, 5,000 Hz.
Finish: Oiled Walnut Finish.
Dimensions: 14-3/8"(W), 23-5/8"(H), 11-13/16"(D).
Weight: 33 lbs. (Net).
Accessories: 3 kinds of Saran grilles.
Cord with a chip for connecting an amplifier.

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Type: Acoustic Suspension Speaker System.
Speakers: 12" Woofer, Orthodox Mid-range Horn unit, two 2" Horn Tweeters.
Frequency Response: 25 – 20,000 Hz.
Power Rating: 50 watts (Music).
Impedance: 8 ohms.
Crossover Frequency: 800 Hz, 5,000 Hz.
Finish: Oiled Walnut Finish.
Dimensions: 14-3/8"(W), 23-5/8"(H), 11-13/16"(D).
Weight: 35 lbs. (Net).
Accessories: 3 kinds of Saran grilles.
Cord with a chip for connecting an amplifier.

for the constant current approach referred to earlier, typical program material is unlikely to contain enough high frequency amplitude to exceed the dynamic limits of the tape.

Prerecorded tapes are now freely available at three well-recognised speeds: 7½, 3¾ and 1⅞ inches per second. It can be assumed that prerecorded tapes will contain a certain amount of treble boost, as per figure 1, determined on the basis of the tape speed and the anticipated performance of good quality heads with which the recording could be played back.

For readers who may be interested, certain standardised tape compensation curves were included in an article entitled "Transistor Tape Preamp for Stereo," which was published in the December, 1964, issue. (Also included in the article was the R.I.A.A. disc replay equalisation curve which is the accepted standard for all microgroove disc recordings.)

While it is possible nowadays to manufacture heads with gaps of the order of a few ten-thousands of an inch, utilising oxide layers for gap spacing, and which substantially conform to standard requirements, there is still a very large variation in roll-off frequency between heads of various qualities. With old or worn replay heads, the treble response may be limited to half or less that of a modern, good quality head.

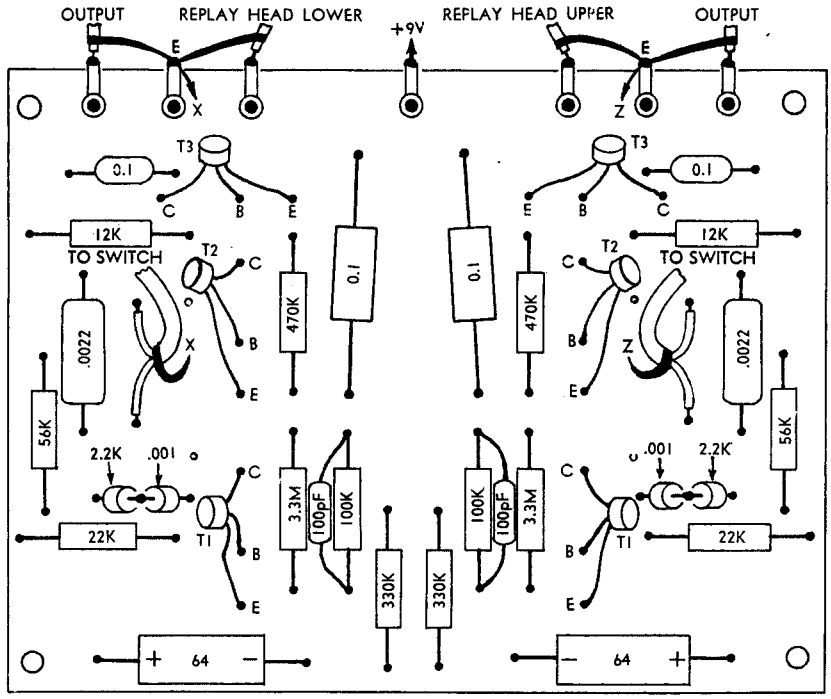
The compensation provided in the preamplifier to be described assumes a good quality head and, with such a head it will give a response which is substantially flat to the limits of audibility for a tape speed of 7½ips. At 3¾ips the response should be to about 10KHz, and to about 7KHz at 1⅞ips. The very best heads may improve on these figures, while the older ones will be hard put to it to achieve the one-time objective of a response in Kilohertz equal numerically to the tape speed in inches per second.

With poorer heads the treble response may be improved somewhat by providing treble boost lower down in the range and/or by use of treble boost in the main amplifier chain. How much boost should be used, however, depends on whether there is signal available to be recovered and by the inevitable deterioration in signal-noise ratio which will be occasioned by the use of treble boost for playback. More will be said about this later.

The preamp design is derived from the multi-function equalisation preamplifier for magnetic pickups and tape heads described in the October, 1965, issue. As originally presented, the preamp could be wired to provide either R.I.A.A. disc equalisation or C.C.I.R. tape compensation.

The preamplifier has facilities for varying the input impedance, gain and replay treble boost to suit the particular tape head being used. Furthermore, the noise performance is about as good as can be achieved with currently available transistors.

In the initial stages of seeking a suitable preamplifier design, we did spend some time looking at alternative approaches with a view to deriving a configuration which possibly would use only two transistors. However, we found that the requirements of sufficient gain (including that required for compensation) and of low noise were partly in conflict and that, in satisfying one requirement, we had to sacrifice the other.



The component layout diagram for a stereo preamplifier shown above will assist with the placement of most components on the printed wiring board.

List of Components

1 Printed wiring board, 65/p10.
1 1-pole 3-position or 2-pole 3-position wafer switch, as required. See text.
Power supply components, as required. (See text).

TRANSISTORS

2 BC109, TT109 or SE4010 low-noise NPN.
1 AY1104, 2N3638A PNP.

RESISTORS

1 3.3M, 1 x 470K, 1 x 330K, 2 x 100K, 2 x 56K, 1 x 22K, 1 x 12K, 1 x 10K, 1 x 2.2K.

CAPACITORS

1 64uF 6VW electrolytic.
2 0.1uF LV plastic.
1 .0022uF LV plastic.
1 .001uF LV plastic.
1 100pF LV plastic.

The investigation seemed strongly to suggest that the 1965 preamplifier still represents about the best all round approach to a high-gain low-noise design with currently available transistors. This seems to apply equally for disc and tape requirements.

As may be seen from the circuit diagram, the preamp. uses two low-noise NPN silicon transistors (T1, T2) and one standard PNP silicon transistor (T3). Transistors T2 and T3 are connected in a direct-coupled feedback amplifier circuit which is used to provide compensation, while the input transistor T1 is used as a low-noise high-gain preamplifier stage.

Local negative feedback around T1 reduces the input impedance of the stage to a low level, creating a virtual earth at the input. The effective input impedance is then set by the addition of a resistor (100K) in series with the input connection. The value of this resistor also determines the gain of the input stage, as a result of negative feedback action via the 3.3M between collector and base of T1.

For medium to high impedance heads, commonly intended to feed directly into valve grid circuits, the input impedance can typically be of the order 47 to 100 Kohms, unless the head manufacturer specifies some distinctly different value. For heads which are known to be of low impedance, the input impedance of the preamplifier can be reduced proportionately, by reducing the input resistor(s). This will also result in an increase in preamp. gain, to cope with the inevitably lower output from low impedance heads. Ideally, the small capacitor shunting the input resistor should be reduced proportionally when this is done; however, if the resistor(s) are reduced below 22K the capacitor(s) may simply be omitted.

Compensating frequency response is provided by the single time constant network, consisting of a resistor and capacitor in series, between the preamp output and emitter of T2. The series resistor is switched to provide the appropriate F2 turnover point for the particular speed being used.

Adjustment of the compensation component values may in some cases be necessary to obtain optimum replay frequency response with the particular tape head(s) concerned. In general, if on a given speed setting there appears to be insufficient bass relative to mid and high frequencies, the value of the switched resistor may be reduced, and vice versa.

A small amount of replay treble boost is provided by the preamp, this

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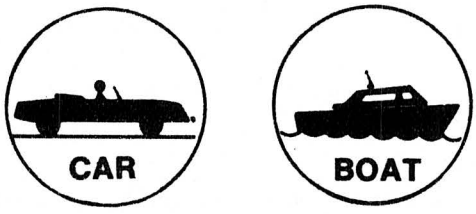

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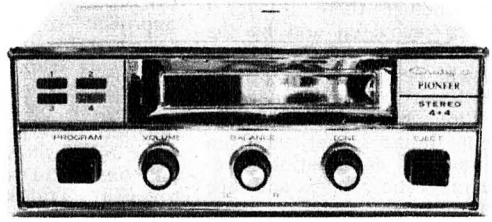

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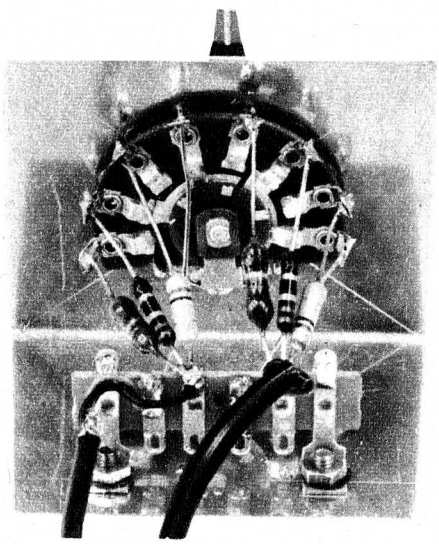
being common practice and applied with the idea of "reinforcing" the usual recording pre-emphasis. In this instance the boosting is provided by the .001uF capacitor and 2.2K resistor providing partial bypassing of the emitter of transistor T2.

With higher performance heads the degree of replay boosting provided may be excessive, in which case the high frequencies may seem unduly prominent on all speeds. If this occurs the degree of boosting may be reduced by reducing the bypassing capacitor from its specified value of .001uF. Conversely this capacitor may be cautiously increased in value if the response of the head(s) used is sufficiently limited to result in an obvious treble deficiency.



A photograph of the compensation-switch assembly is shown at left. The various resistors in the compensation networks are wired directly from the switch to a tag strip on the mounting bracket which, in addition, acts as a shield for the switch wiring.

The 2.2K resistor in series with the boost capacitor should not be reduced in value or omitted, unless the capacitor itself is found unnecessary (as might well occur with the highest performance heads). In this case both components may be omitted. But if the capacitor is retained, the resistor is also required to ensure stability of the preamp. at high frequencies.

The circuit diagram shows a mono preamp; the circuitry is merely duplicated for stereo tape reproduction. A suitable printed wiring board (65/p10) for the construction of a stereo preamp is available from the usual wiring board suppliers. If mono only is required it should usually be sufficient to wire up only half of the printed board, with the option of converting to stereo later. Alternatively it might be possible to cut the board in half if space were to be conserved.

The prototype preamp was wired in stereo and housed in a small metal utility box measuring 4in x 4in x 2½in. While to a large extent the location and housing of the preamp will depend upon the deck and case used and on individual requirements, adequate shielding is necessary to prevent hum and stray signal pickup. If the board is located under a tape deck particular precautions should be taken against hum induction from the motor windings.

Some tape decks have a switch attached to the speed selection facility for changing the compensation as the speed is selected. If such a switch is available, the compensation-network resistors may be wired directly to it, with suitable shielded leads connecting to the appropriate positions in the preamp wiring board. In some instances the switch may not be provided as such, but the deck may provide a shaft which is an extension to the changing mechanism, and to which may be fitted a suitable switch wafer.

For mono, a single-pole three-position switch will be required, but if a stereo preamp is to be used this will involve a two-pole three-position switch. If it is not possible to include the switch as part of the speed changing mechanism it could be fitted to a small bracket, as in the prototype, and mounted thereby in any convenient position.

Alternatively, the complete preamp, including the switch and resistors, could be mounted in the main power amplifier case, deriving the modest power it requires from the amplifier supply. On the circuit diagram we have shown three alternative supplies, one of which should be sufficient to meet most likely situations.

For our prototype, we used a small 9V battery clamped to the lid of the box. With a current drain of a little less than one milliamp, even for stereo, the battery should provide quite prolonged service. However, we did include a small slider on/off switch in series with the supply.

If the preamp is mounted under a tape deck it may be possible to connect the low voltage rectifier supply to an auxiliary motor winding. Alternatively, the high voltage zener supply could be used if the preamp is included in a valve amplifier. If a transistor power amplifier is used the supply will probably be considerably less than 150V, in which case the 22K 5W resistor could be reduced to suit.

There are a few points which may be helpful in the assembly and connection of the printed wiring board. Despite the relative simplicity of construction, care should be taken when wiring a printed board with special attention being given to the transistors. These should normally be wired last of all.

Care should be taken to ensure that no component is subjected to excessive heat during soldering, as this can produce disastrous results especially where transistors are concerned. A small, well tinned iron will produce best results, briefly applied to localise heat in a small area. In this way a secure soldered joint can be made with minimum heating of the components and the board itself.

When inserting the capacitors and resistors their leads should not be bent excessively or too close to the component body. It is recommended that transistor leads be cut not shorter than about ¼in. When soldering transistors it is often a good idea to hold the leads with a pair of long-nosed pliers which will act as a heat sink between the iron and the "header." In this way the transistor's interior will be protected from excessive heat.

When the wiring is completed, the voltage at the output collector(s) should be measured, and should be about 5V. If not, the 330K bias resistor to the first transistor should be adjusted to correct the situation. Increasing the resistor value will reduce the output voltage, and vice versa.

When the preamplifier is connected to the tape head and the main amplifier it is necessary to take special steps to avoid the introduction of hum via common earth loops. Basically, there are two satisfactory schemes for connecting the preamp. In some instances one method of earthing may give better results than the other, and vice versa.

The first method is to disconnect the tape deck and motor assembly metalwork from the "deck" mains earth and tying it to the signal earth path which passes through the preamplifier to the power amplifier. In most cases the replay head will have both ends of its winding isolated from the metal case and shielding assembly which are of necessity connected to the deck. The preamp input shielding braid will be connected to one side of the head winding and bridged to a suitable spot on the deck. With a stereo system, only one shield braid should be connected to the deck in this fashion.

The alternative scheme is to connect the deck earth to the mains earth, but to isolate it from the signal earth path. The input shielding braid from the preamp should be in this case connected to the head winding only.

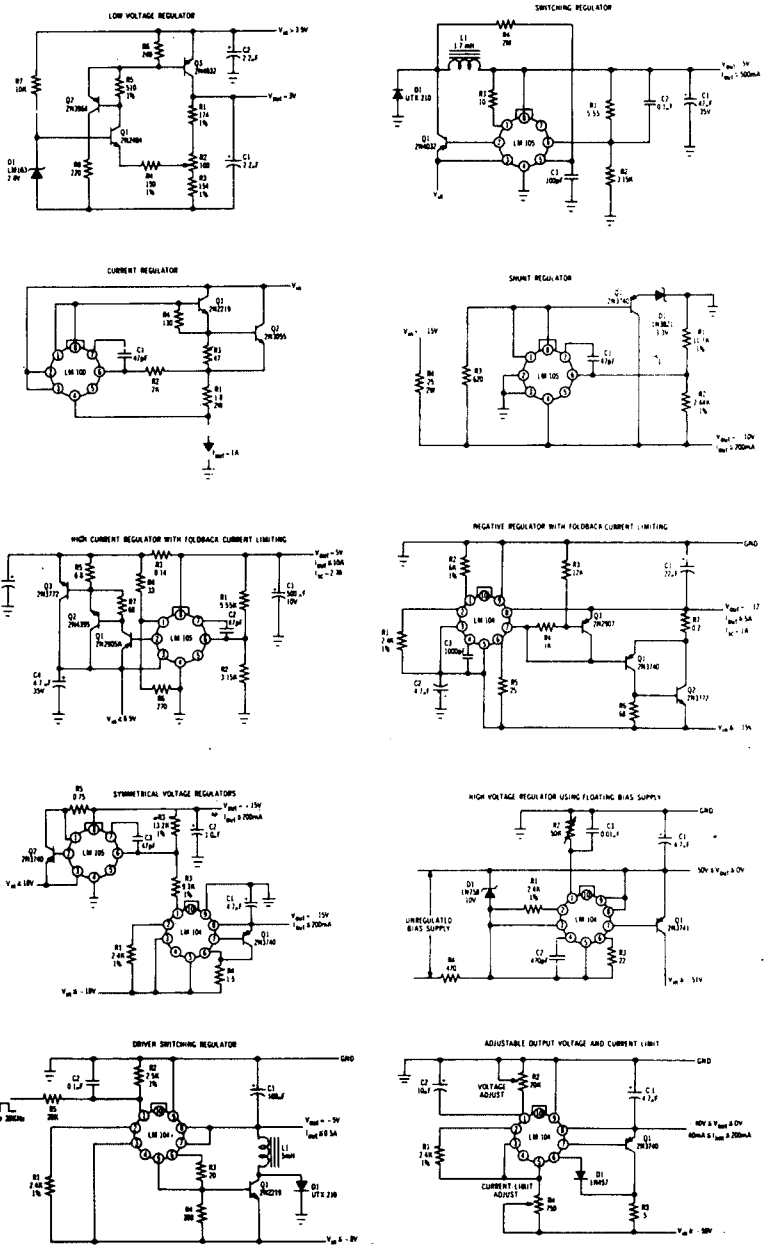
If desired, both of the above earthing methods may be tried in order to determine which gives best results. ■

SEMICONDUCTORS

(Continued from page 55)

cuit the operating parameters were largely fixed by the device itself, in the latter they are mainly a function of the external divider formed by R1 and R2, and therefore may be varied by the designer at will over a wide range. As a result the circuit may be arranged to operate over a considerably wider frequency range than the circuit of figure 2(a), and over a wider range of supply voltages. The faster switch-on and lower "on" resistance of the PUT also provide output pulses of higher amplitude and shorter rise- and fall-times.

Despite the advantages of the complementary thyristor when used as a PUT, it tends to be rather easier to to manufacture than the normal UJT, and as a result tends to be somewhat lower in cost. It is therefore likely that the PUT may gradually displace the UJT in many if not all applications. (J.R.) ■



Some Thoughts On Crystal Controlled Clocks

By Ian Pogson

Is it possible for the home constructor to build himself a crystal controlled precision clock? What order of performance could be expected? Can such a clock be made portable and self contained? These, and many similar questions are discussed in this article, arising out of recent experiments and investigations in our laboratory.

About 12 months ago, our mail brought the first of a current series of requests for a crystal clock. Since then, interest has quickened and we have had many letters showing interest in such a project. These letters have contained many suggestions and requests as to the facilities and characteristics which such a clock should have.

It is safe to say that there have been almost as many ideas put forward as there have been letters. This is most encouraging and, indeed, presents the writer with quite a challenge to meet as many as possible of these ideas. To give the reader some idea of the requests and ideas put forward, here are extracts from some of the letters received.

" . . . Would you consider running a project for home construction, using a compact stable frequency source for an accurate, portable transistorised crystal controlled clock? There must be a wide demand for such a unit, especially among amateur astronomers, radio amateurs, weekend navigators, yachtsmen, satellite watchers, and so on. A suitable unit could be made to drive a synchronous clock movement. Being interested in navigation, I would appreciate a reliable time source with an accuracy of plus or minus one second in 24 hours."

" . . . I think that such a clock would be a boon to large numbers of people, especially to provide frequency control for telescope drive motors. If it were developed, could it include a means of making it run 3 min. 56 sec. fast in 24 hours to provide sidereal time for amateur astronomers? . . ."

" . . . I think a digital readout might be preferable to a clock movement since, by its very nature, it gives an accurate reading at a glance. The second hand of a clock movement is considerably harder to locate precisely at any particular moment, because of the relatively rapid and continuous movement . . ."

" . . . Digital readout would certainly make an impressive display. However, I imagine that this approach might be prohibitively complex. I believe there is one essential with such a clock; it should be absolutely silent. (Ticking clocks are a pet hate of mine!) You have probably seen it, but there is a section in the G.E. Transistor Handbook which describes a crystal clock employing a crystal and tunnel diodes . . ."

" . . . A 50Hz clock could be simply rewound to suit a lower voltage . . . I find the ticking of clocks most satisfying!"

" . . . (1) The clock should be designed for 12 volt accumulator operation aboard boats; (2) It should have a slave dial which could be stopped at the moment a sextant sighting was taken; (3) It should have a 24 hour readout dial capable of being set to GMT . . ."

". . . I would like to suggest that such a power supply could also be used to drive a synchronous tracking motor for a small astronomical telescope. These motors are designed for 240 volts and draw between two and three watts . . ."

The foregoing list gives quite a fair cross section of the suggestions received. To continue a little further, one reader requested an "all stops out" version. He writes in substance, that he would like to go ahead with a crystal clock: Self-contained portable, alternative mains and battery supply, two dials, local time with 24-hour face and sidereal time, with sweep second hand, 50Hz output suitable for driving a telescope, inbuilt amplifier for high power output when using mains supply, optional digital readout facility . . . .

At this stage, the writer feels that it would be just about the right time to retire from the field! Undaunted however, by such a specification, we also have on the desk a very helpful list of suggestions from a qualified navigator and yachtsman. At the risk of labouring the subject, here is a digest of his suggestions:

(1) Price — not serious but should compare with standard chronometers in this regard.

(2) Size — compact.

(3) Power supply—independent and readily available.

(4) Readout — open to personal choice.

(5) Time — GMT, 24-hour.

(6) Accuracy — chronometer tolerances.

(7) Setting and adjustment — facilities for setting time and rate.

(8) Construction — rugged, light and portable.

(9) Accessories — provision for slaves, at least one with hold facilities.

(In regard to item (6) the specifications for a typical marine chronometer, issued with a certificate, are that it should not vary more than ± 1/5 second per day from its mean daily rate).

The reader may well ask, why the need for a crystal controlled clock anyway? This is a good question, as the argument could be put forward that we have only to obtain a synchronous clock movement for a modest price and plug it into the mains supply in order to achieve an acceptable accuracy.

For catching a train or bus this is more than a sufficiently accurate source of time. Observations show that a mains operated synchronous clock deviates from the correct time, over any given 24 hours, by about two seconds only, or perhaps a little more in exceptional circumstances. These deviations are more or less ironed out over a 24-hour period and the long term time keeping is very good indeed.

On the other hand, there are many instances where the short term deviation of two seconds or so is just not good enough for the calculations involved. Furthermore, the synchronous clock, when used from the mains, is restricted to more or less permanent installations. It is not suitable for mobile use, or where a mains supply is not available. There is also the individual who, for the sheer satisfaction of having a timepiece which he can adjust himself, likes to chase the ultimate in time-keeping accuracy.

To summarise, if time is required to an accuracy of a fraction of a second per day, and a mains supply is not available at all times, then a crystal controlled unit, operated from suitable batteries, will meet this requirement.

Armed with all this information, we set out to study the position as care-

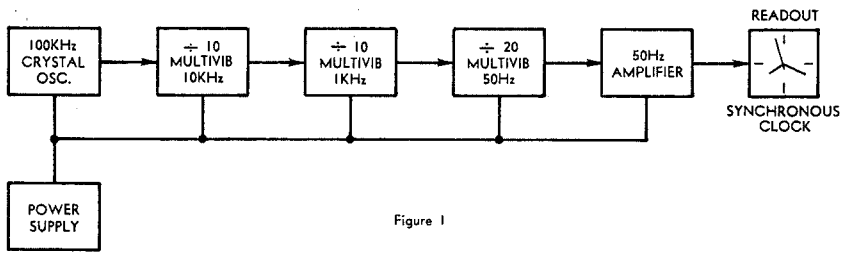


Figure 1

This is the simplest arrangement which we suggest for a successful crystal controlled clock. A prototype is currently being tested. See photograph on page 67.

fully as possible. Before attempting any of the technical design which would be involved, we had a look around at some of the commercially available crystal clocks. There is quite a range available, with wide variations in approach, according to requirements. As near as we can determine, such units range in price from about $275 to thousands of dollars for some of the elaborate industrial installations.

Starting with the lower cost type of unit, which by no means suggests an inferior product, the German made "Junghans" is a straightforward instrument and would be ideal as a domestic mantel clock. The crystal is on a frequency of 12.8KHz and this is divided by flip flops, by 1024 times, to 12.5 beats per second. This drives an electromechanical transducer, which in turn drives the hands of a conventional dial. The clock is powered by one 1.5 volt dry cell and the current consumption is of the order of 0.6mA. The time-keeping accuracy is quoted as being about plus or minus 0.1 second per day.

A somewhat more versatile instrument is the Japanese "Seiko" and it appears that there would not be a great deal of change out of $1000. This one is presented in a case with a sloping front, such that it could be used as a wall clock. The crystal is on 6.269388KHz, which is divided so that it drives a lower power consumption synchronous motor. Power requirements are two 1.5 volt dry cells and the current consumption is quoted at 0.8mA. Time keeping qualities appear to be about the same as the previous unit. Facilities are provided, by push buttons, to advance or retard the indicated time.

Moving up the price and complexity scale, our attention is drawn to a unit produced locally by E.M.I. This features a digital display and the stability is quoted as plus or minus 10 milliseconds per day. It uses a 2MHz oven-controlled crystal and frequency division is via a string of integrated circuits. As well as the time display, output pulses are available at 1 second, 10 seconds, 1 minute and one hour. Two outputs at 50Hz are also available, one at 4 volts peak-to-peak and the other 230 volts RMS, supplying up to 50VA.

In addition to these features, an inbuilt comparator provides for checking against external standard time pulses and the error is brought up on a special display. Facilities are also provided for correcting any error in the display. In the event of the mains supply failure, automatic changeover is arranged to a 24 or 12 volt battery supply, without loss of time keeping. The cost of this type of instrument is of the order of $1400, plus tax where applicable.

Another source of crystal clocks in such variety that they take up quite a sizeable catalogue, is the Swiss "Patek Philippe" organisation. They list numerous units, from one comparable with the first two mentioned, up to comprehensive master clock systems. Rather than attempt to make even a brief survey of this line, perhaps interested readers could contact Australian Time Recording Co. Pty. Ltd., 328 Prince's Highway, Rockdale, N.S.W.

From this brief and limited survey of the crystal clock field, it is clear

that most needs and tastes are catered for on the commercial market. However, we are more concerned with the "do it yourself" type. With this in mind, we will consider some of the possible ways in which this project may be approached.

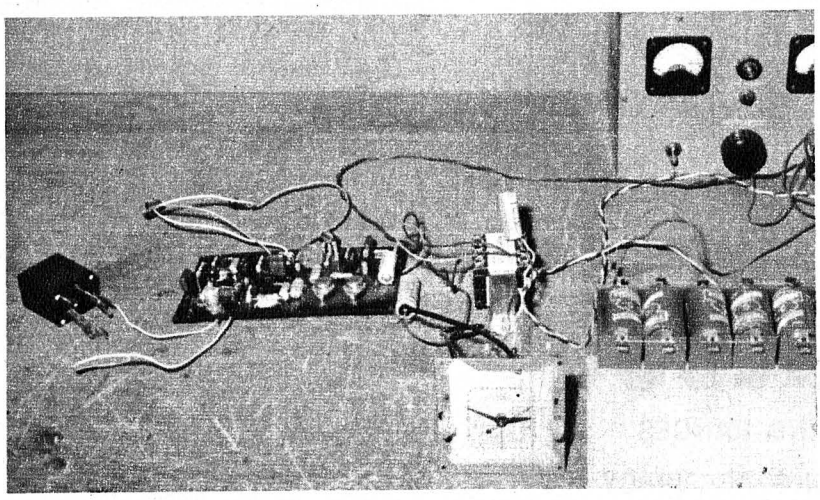
For a start, we will put aside any facilities which may be considered as "extras" and concentrate on as simple an approach as possible. We may start off with a 100KHz crystal oscillator. Although there may be variations on this argument, the 100KHz crystal is normally readily available, capable of good frequency stability, and consistent with the need for a reasonable number of frequency dividers.

Again, because it is readily available, we will choose an ordinary 240 volt 50Hz synchronous clock movement. These movements consume a nominal 2 watts but they usually will run on somewhat less than this. Synchronous movements have been made from time to time which consume power of the order of only 300 to 500 micro-watts. Unfortunately, we have not been able to locate any local source of supply and so we must content ourselves with the other type.

Having established what will be used at each end of the device, we now have to decide how we are going to convert the 100KHz from the crystal, to 50Hz for the motor. Perhaps the simplest way of doing this is with free-running multivibrators. One of these may be used to divide by 10, when locked to the 100KHz oscillator output. By dividing, in the same manner, the 10KHz from the first mulbivibrator we obtain 1KHz. Now this still has to be divided by 20, to reach 50Hz. This may be done in two stages of say, 4 and 5, 10 and 2, or for reasons of economy, we may even attempt the division of 20 directly. As we are adopting as simple an approach as possible, we will asume this last method.

One facility for which this general arrangement lends itself, is that of making adjustments of indicated time to compensate for any residual drift. One of the multivibrators, say, the one which divides by 20, may be adapted so that by simple switching, the division may be shifted to either 19 or 21 as required, to make slight adjustments one way or the other, while the button is depressed. This will provide a correction of approximately 3 seconds for every 60 seconds the button is held down.

Having reached our objective frequency-wise we must amplify this signal to a level which will drive the 2 watt clock movement. An ordinary transistor audio amplifier can be used for this purpose but, because the output impedance of transistor power amplifiers is low, the voltage will have to be stepped up to suit the clock motor.



An experimental version of figure one. The crystal is on the left of the main circuit board, which carries the oscillator, divider, and power output stages. At right rear is the power supply and, in front of it, a set of dry cells to take over in case of power failure.

In other words, an impedance match must be effected.

This impedance match can be conveniently achieved with a conventional audio or power transformer, having the correct turns ration and power handling capability. This presents no problem and many readily available transformers are suitable.

Having satisfied our basic design, power requirement is the next major consideration. The crystal oscillator uses two transistors, and each of the three dividers two transistors, making eight in all. The power supply requirements for this section are very small indeed. Conservatively, it requires 4.5 volts and little more than one milliamp current drain.

However, the real power consumption problem arises when we need to provide a power output of at least 1½ watts to drive the clock motor. As we have already set a design limit of 12 volts DC supply voltage, we have to design an amplifier which will operate at this voltage, with good efficiency, and deliver the required power. As it turned out, we found that an existing design, originally rated at 10 watts from a 24 volt supply, satisfied our requirements nicely when operated from 12 volts and modified slightly to favour efficiency rather than purity of waveform. Current drain is of the order of 250mA.

This is quite an effective setup, but somewhat outside the scope of use from dry cells, on an economical basis. However, this drain is quite modest when run from a 12 volt accumulator and can be considered as satisfactory.

This design would be restricted in its use by virtue of its power requirement. However, it should be well suited to fixed use where this power can be provided, as well as to mobile use in trucks, cars and boats. The accurate time provided could be used for navigation, surveying and many other uses which require accurate time not otherwise readily available.

An experimental clock along these lines has, in fact, been built in our own laboratory, and is currently undergoing time-keeping and reliability tests. As can be appreciated, time-keeping checks on any clock which has a potential of, say, one second per week, can only be performed over a long period of time.

Another possible approach which is occupying the thoughts of the writer, is to replace the 50Hz synchronous movement with quite a different type of movement. We refer to those battery operated clocks currently on the market, which run from a single dry cell, with a balance wheel or electromechanical transducer, operating at five beats per second. Switching is accomplished with a single transistor. These movements are rugged and reliable and consume about 200 microamps at 1.5 volts.

The switching just referred to is accomplished by feeding an electromagnetically produced pulse from the balance wheel and a coil, into the base of the transistor. This turns on the transistor at the correct moment and allows collector-emitter current to flow, through another coil winding. This gives a maintaining pulse to the balance wheel. From the balance wheel, through a train of gears, the hands are driven. Such a movement performs very well within the limits of a simple mechanical movement.

The thought arises that, instead of driving the base of the switching transistor from within its own enclosed system, we may be able to drive it from an outside source of pulses, derived from a crystal oscillator. On the assumption that this can be done, the five pulses per second could be obtained from a crystal oscillator on, say, 100KHz. This could be divided in

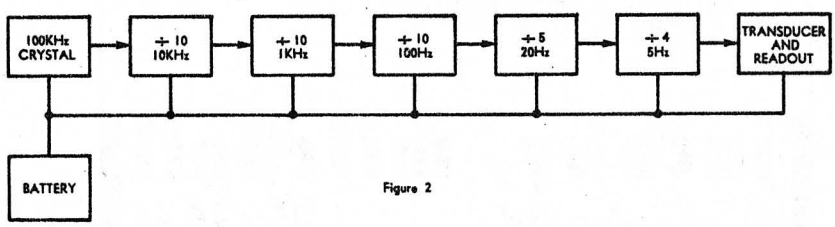


Figure 2

Here is another possible approach, still using a minimum of dividers, but using a battery operated clock movement as the readout device.

stages to the required rate. The resonant rate of the balance wheel, or electromechanical transducer, being normally set to make five beats per second, it is then proposed to keep the transducer synchronised with the incoming pulses. By this means, we have a precision time-keeper, controlled by the crystal.

Let us take a closer look at this idea. In its simplest and most economical form, we could start with a 100KHz crystal oscillator, as in the previous example. Also, we could divide by 10 in each of three stages and then divide by 20, either directly, or by, say, four and five. This arrangement would give the minimum requirements, with the smallest number of components and cost.

If we make the reasonable assumption that the crystal oscillator, each of the five divider stages, and the movement, all consumed an average of 250 micro-amps each, the total current drain would be 1.75 milliamps. This is becoming a proposition for use with ordinary dry cells. Under these conditions, it would be reasonable to expect several months service from one set of dry cells. The block diagram of this suggested arrangement is shown in figure 2.

Synchronised multivibrators, used as dividers, can be made to function very satisfactorily, provided suitable precautions are taken. However, they are not absolutely reliable and foolproof. It is possible for them to drop out of lock and so run at a frequency slightly lower, or perhaps higher, than the correct one. It is also possible for synchronising to "jump a tooth" and lock in at say, 9 or 11, instead of the required 10. If either of these events should occur, then the results can be quite serious. The system no longer is delivering the correct frequency at the output of the chain and in our case, the clock no longer keeps the correct time.

In addition, should any one multivibrator stage, or the crystal oscillator, fail completely, the following stage will continue to run, but at its natural frequency, which is normally lower than the locked frequency. The following stages may or may not remain locked but, in any case, the clock will continue to run with nothing to indicate that it is running incorrectly, probably slow.

There is a way out of this problem. Instead of synchronised, free-running multivibrators, we can use bi-stable multivibrators or flip-flops. These are completely fool-proof and reliable. However, there is a price to pay for these advantages. Instead of being able to divide by relatively large amounts, such as 10 or even 20, we can divide by only two in each stage. This means that many more stages will be needed to do a similar job.

Let us assume again, that we wish to drive a transducer at five pulses per second as before. This means that we will have to multiply by factors of two until we reach the order of crystal frequency that is proposed. Therefore, we will start from 5, multiply to 10, 20, 40, 80, 160, 320, 640, 1280, 2560, 5120, 10,240, 20,480, 40,960, and finally to the crystal frequency of 81.920KHz. This requires 14 divisions from the selected crystal frequency, to get down to the five pulses per second.

It will also be clear that if we start

off with a certain pulse rate requirement, five per second in this instance, we end up with anything but a nice round figure for our crystal frequency. This is no problem, fortunately, as crystals may be ground just as easily to some odd sort of value, as to a nice round figure, such as 100KHz. However, it does preclude the use of existing "standard" crystals, such as the 100KHz types that have been readily available through disposals.

Having evolved a much more complex system, to obtain the maximum reliability, the cost of components will increase accordingly, space requirements for these components will also be greater, together with a proportional increase in power supply current. The block diagram for this system is given in figure 3.

The system of figure 3 does not readily lend itself to making small corrections to the second hand. By making a modification to the system, and accepting a degree of compromise, we should be able to do this. Experience has shown that a well-designed crystal oscillator, operating at around 100KHz, and a 10 times division multivibrator operating from it, can make a very reliable combination. If we start off with 102.4KHz the circuit can be so arranged that by operating a push button, we can divide in this stage by nine or eleven, thus giving the correction facility. Following the division by ten, we can continue our divisions with binary stages, dividing by a further 1024, which gives five pulses per second. Figure 4 shows this last suggested system.

Since writing the foregoing on the subject of synchronising the battery-operated clock movement on five beats per second, we have taken a closer look at the idea. Investigations, although not at all complete at this stage, indicate that the problem is not an easy one to solve. It is quite easy to supply pulses at five per second, into the base of the switching transistor, but it appears to be another matter to lock the transducer in with the pulses.

Clearly, there is more work to be done along these lines, before we can decide as to whether the idea is a practical one or not. A serious effort will be made to solve this problem, as all the techniques are readily available to produce a first-class and economical crystal clock, except this small gap which still has to be bridged. It is interesting to note that the Junghans clock previously referred to, uses this method. However, there is one difference as we see it. The Junghans transducer beats at 12.5 per second, whereas the one we are attempting to synchronise beats at five per second.

Let us turn now to some of the requests made for various facilities and see what could perhaps be done about them. We have already checked on the need to be able to alter the second hand, to correct for drift, etc., and this does not seem to present any problem. Extending this concept further, facilities for setting the minute and hour hands should present no problems either.

The facility for setting the rate (regulation), is quite straightforward. This is simply achieved with a high grade trimmer in the crystal oscillator circuit. Given a suitable trimmer, it should be possible to set the rate of the clock to within 0.1 second per day. This is well within the limit of one second per day, as proposed by some readers.

Whilst we are on the subject of the oscillator, mention should be made of the possible effect of temperature on the rate of the clock. This can become quite involved and we can only make relevant comments at this stage. Needless to say, the time-proven method of placing the crystal in an oven, which is heated and thermostatically controlled, is one way out of the problem. However, for anything but a fixed installation, where power consumption is no object, this approach is not a practical one.

If we are to use a crystal around the 100KHz mark, then a GT cut crystal could be used. This cut has practically zero temperature coefficient, over a wide temperature range. Unfortunately, this type of crystal is very expensive and as far as we can ascertain, it is not readily available in this country. If this crystal were used, the temperature parameter could be put to one side and steps could then be taken to compensate for variations in transistor parameters and other component variations.

This arrangement is similar to that of figure 2 but with the important difference that it uses flip-flops, in the divider chain.

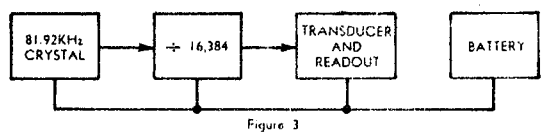


Figure 3

Still considering crystals around 100KHz, the DT cut is readily available and this has a temperature curve which is parabolic in shape. Manufacturers are able to make this crystal with the turnover point of the parabola set at any reasonable temperature, within a tolerance of plus or minus 10 degrees Celsius. At either side of the turnover point, the temperature coefficient is negative. Given the specific information on a particular crystal, steps could then be taken to provide at least a measure of temperature compensation.

This one uses a multivibrator to divide by ten in the first stage, followed by flip-flops.

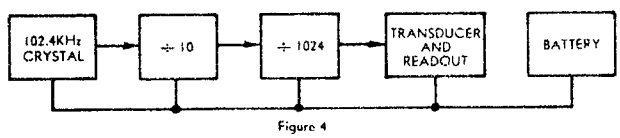


Figure 4

Another popular cut of crystal in the same frequency range, is the plus 5°X. This has a similar temperature curve to the DT cut, but it turns over at about 47 degrees Celsius and this cannot be moved. However, this is not necessarily a disadvantage, as operation is most likely to occur below the 47 degree turnover point. This means that the crystal will be operated on a steep slope of the temperature curve and being negative, this could be at least somewhat offset by components in the circuit with a natural positive temperature coefficient. If this is not enough, then it may be possible to deliberately introduce a capacitance with a positive temperature coefficient.

Even if no attempt is made to introduce any temperature compensation into the oscillator circuit, the timekeeping may still be within the requirements of many users.

Finally, if a crystal such as one from disposals sources, is to be used and the characteristics are not likely to be known, then one must be prepared to accept the results which are obtained. Even so, it may be possible to carry out some experiments with the object of improving the performance of the particular crystal. In point of fact, some experience which we have had with such crystals indicates that they can put up quite a good performance, such that they could be satisfactory for many applications.

In cases where it is expedient to use a crystal of some frequency far removed from 100KHz, then certain differences would have to be considered, each on its merits. As this could be a big subject, we do not propose to go into it at present. Suffice to say that many of the foregoing remarks would still be relevant.

While still on the oscillator circuit, the matter of alterations for sidereal time can be discussed. It does not matter whether you want sidereal time for the actual time itself, or to drive a telescope, etc., the change to the oscillator will be the same. In fact, the change is a very simple one, the crystal being the only alteration. As there are 86,400 seconds in one day, with respect to civil time, there are 86,164 of these same seconds in one sidereal day. This means that if we want sidereal time, we multiply the crystal frequency which gives civil time, by 86,400 and divide by 86,164, to get the frequency of the new crystal. This amounts to a multiplying factor of 1.002739.

An article elsewhere in this issue of the magazine deals at some length with aspects of time and frequency standards. The reader is referred to this if his interests run in this direction.

Perhaps one of the tougher requests was to provide both civil and sidereal time from the one crystal. While this can be done to a close approximation, the extra complexity of the circuit makes one think that it may be better to make two separate clocks, one for each function.

Another request is for a 24-hour readout dial, suitable for indicating GMT. Twenty-four hour dials and movements are available, the latter normally being suitable for 50Hz operation. The selection or design of a suitable dial would be a matter for individual choice, but there is plenty of scope for imagination here.

The question of providing more than one dial is an important one for some specific functions. In the case where the clock is being used for navigation,

(Continued on page 174)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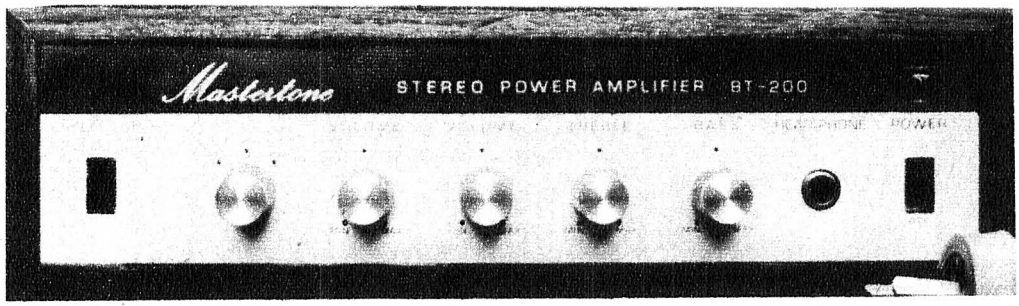

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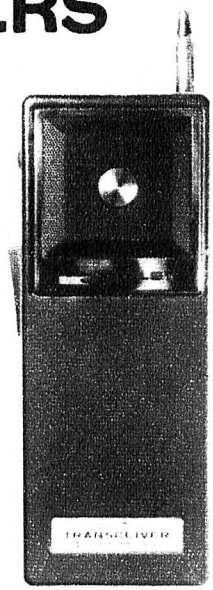

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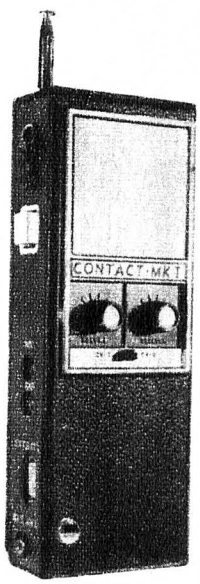

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Dependable, doubtful or dangerous?

TRANSISTOR OSCILLATOR/TESTERS

Following last month's article on testing transistors with a multimeter, it is logical to consider another simple testing technique which is mentioned from time to time in technical literature, and based on the ability of a transistor to operate in a mock-up oscillator circuit.

At first glance, the idea appeals as being quite logical and particularly attractive to beginners, because it represents something they can build and try at a minimum of expense.

The idea is to collect the components necessary to put together a simple audio oscillator, coupled directly to a loudspeaker. It is normally powered from one or more torch cells, with a switch or other means to reverse the battery polarity so that it can be used with either NPN or PNP transistors. Clip leads are provided so that any transistor to be evaluated can be coupled quickly into the circuit.

The assumption is that if the transistor is functional, the circuit will oscillate and an audible tone will be heard from the loudspeaker. On the other hand, if either junction is faulty, or the transistor is suffering from any kind of internal short or open-circuit, oscillation will not occur.

It is one case, at least, where silence is not "golden!"

The claim is sometimes made that such devices can be used to test transistors "in situ." In other words, by clipping the leads to the emitter, base and collector of each transistor in turn, in a receiver or other equipment, it is possible to pick a "dud" transistor by its failure to oscillate.

In fact, such an assumption may be quite invalid. In high frequency circuits particularly, associated tuning coils may represent a very low impedance at audio frequencies and failure of a transistor to oscillate may be due, not to the transistor, but to the shunting effect of the circuitry still connected to its base and collector.

If the transistor under test does oscillate, fine! If it doesn't, unsolder it and try again!

In justifying the oscillator kind of "go/no go" test, it is commonly pointed out that transistors do not normally suffer a progressive deterioration in service and that they are quite unlike valves, which suffer a gradual loss of cathode emission and therefore a gradual decline in efficiency. If a transistor fails, it usually does so suddenly and completely.

Therefore, if a suspect transistor is removed from a circuit, a simple test which proves it to be functional can also be interpreted as a fair indication that it is normal in other respects; that one can wire it back into circuit and look for the trouble elsewhere.

While this much can be conceded, it must be stressed that ability to operate in an audio oscillator circuit gives little or no information about many vital characteristics of a transistor: its voltage and current parameters, its gain, high frequency characteristics, noise factor, leakage and so on.

In sorting through oddment transistors, therefore, the most that an oscillator test can do is to indicate those which are positively non-functional by reason of internal short or open circuits. It can give no indication as to the suitability of the "go" transistors for use in particular circuit positions.

In this respect, an oscillator test is no more conclusive than one performed with a multimeter, as outlined last month.

A variety of oscillator circuits has been suggested from time to time for transistor "testbeds," and those in figures 1 and 2 are fairly typical.

Figure 1 involves the use of an ordinary class-A transistor output transformer, "associated with a loudspeaker of about the same voice coil impedance as the transformer was originally intended to work with." The voice coil impedance can be higher than originally intended but lower values presumably have to be avoided because they would load the transformer too heavily and would inhibit oscillation with transistors having a lower order of gain. The circuit was claimed to operate with voltages between 1.5 and 6.0 and can be used with either PNP or NPN transistors by appropriate operation of the 3-way switch. In the centre position, the unit is "off." It is pointed out that the 2uF capacitors must be plastic or ceramic types and not electrolytics, since they have to operate with a different supply voltage polarity for the alternative types of transistor.

Figure 2 is an another suggestion involving an "ordinary push-pull transistor output transformer, as used in B-class output stages." The same observations as before hold in regard to tranformer secondary and loudspeaker voice coil impedance, and the nature of the 2uF capacitor. For

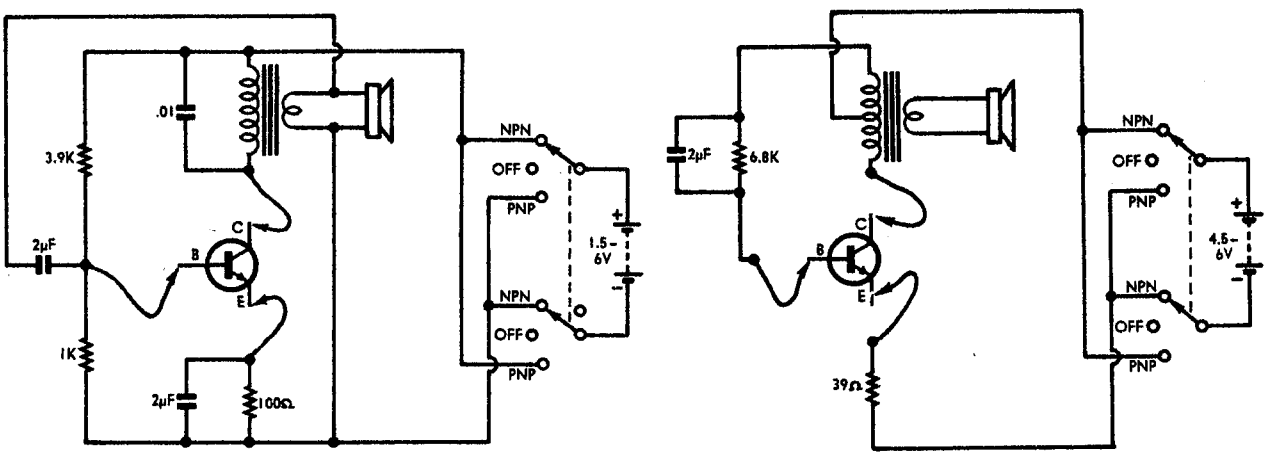


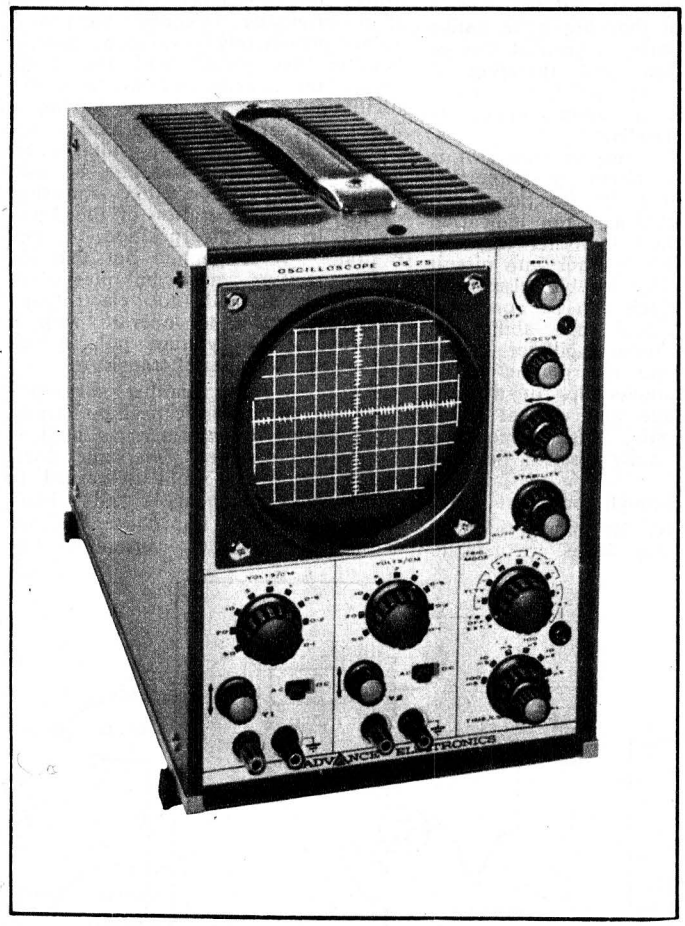
Figure 1 (left) and figure 2 (right) are typical of the oscillator circuits which have been suggested for testing transistors. With a bit of luck, they will work reasonably well and give a reasonably reliable good/bad verdict for ordinary general-purpose transistors. There is a problem, however, that they may fail to oscillate with low gain but otherwise good transistors. Even more serious is the risk of them ruining high-gain transistors having a limited base-emitter voltage rating.

The OS25 has set new standards for a low cost, dual trace oscilloscope. It is rugged, simple to operate and maintain and is attractively styled. Triggering facilities are unusually comprehensive for a low cost instrument of this type and include internal triggering from either channel.

This oscilloscope has a vertical amplifier bandwidth from DC to 5MHz with a maximum sensitivity of 100mV/cm on each channel. The time base gives sweep speeds from 1 sec/cm to 0.5μS/cm using switched and fine controls. The operating mode best suited to the time base speed is automatically selected by the time base range switch; beam switching for the two slowest speeds and alternate sweep for the four highest speeds.

A bright clear display is obtained on a 5 inch helical PDA tube operating at a potential of 3kV overall.

5 MHz Dual Trace Oscilloscope OS25



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reliable operation with all transistor types, a voltage of between 4.5 and 6.0 was stated to be necessary, although it could be reduced to 3.0 with some transformers and, in some cases, with the 39-ohm emitter resistor bypassed with a plastic or ceramic capacitor of at least 2uF.

Circuits along these general lines have been suggested fairly commonly, usually with the observation that they can be built up around oddment components of any reasonable physical size and housed in an appropriate box, with only the switch knob and the clip leads exposed.

Superficially, they seem to give the expected results with the oddment general-purpose transistors that an experimenter is most likely to have collected. However, they are not so readily endorsed by those who have a closer working knowledge of transistors and transistor ratings generally. A question which naturally arises is whether oscillator circuits, if they have enough feedback to operate reliably with old-style low-gain transistors, will oscillate so violently with other types that they may set up peak voltages sufficient to cause junction breakdown. And, even if it is possible to devise circuits which are reliable and non-hazardous, are these very essential conditions likely to be achieved by oscillators lashed up from an assorted array of components?

Short of a rather lengthy exercise with oddment components and oddment transistors, it is rather difficult to be categorical about these simple transistor test set-ups but there is certainly good reason to treat them with a great deal of reserve.

An approach which has much more to commend it as shown in figure 3 and is as submitted for use in our "Reader Built It" feature by Mr. R. Worthington, of 65 River St., Cundletown, N.S.W. 2430.

It uses a medium power germanium PNP transistor as an integral and permanent part of the tester, with a 15-ohm loudspeaker connected directly in its collector circuit. The transistor to be tested is coupled into the circuit as a preceding stage, with feedback taken to its base from the output stage collector.

While the circuit calls for a permanent in-built transistor, it obviated the need for a transformer, with the rather vague impedance ratios and levels which characterise oddment items. More to the point, however, the general approach allows the unknown transistor to be operated under load and current conditions which can be much less arduous than those necessary for a transistor which also has to operate a loudspeaker at an audible level.

Temperature stability of the circuit shown would probably be quite poor but the simple arrangement is probably adequate for a unit where operation is per push button, held down only long enough to determine whether or not the circuit will oscillate.

If readers are keen to experiment with oscillator type transistor testers, the general approach indicated in figure 3 would appear to be much the better one.

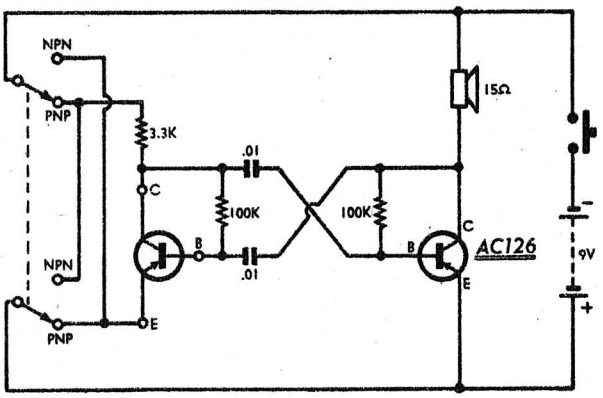


Figure 3: If you want to experiment with an oscillator type transistor tester, do so along these lines. The transistor to be tested becomes part of a two-stage oscillator and is protected much more effectively from voltage overload.

FILTERS FOR 122 AND 123 TUNERS

There appears to be some confusion among readers who are interested in the Playmaster 122 and 123 Wide Band Tuners, relating to three of the ceramic filters.

At the time when the overall design and development work was being done, there were four types of simple ceramic filters being offered by Standard Telephones and Cables Pty. Ltd. These were, EFC-D455K1, EFC-D455K2, EFC-D455K3 and EFC-D455K4. The first two (K1 and K2), have a 3dB band width of 5KHz and the other two (K3 and 4), have a 3dB band width of 8KHz. Of the K1 and K2 types, K1 has a centre frequency of 455KHz ± 1KHz and K2 has a centre frequency of 455KHz ± 2KHz. Similarly, K3 has a centre frequency of 455KHz ± 1KHz and K4 has a centre frequency of 455KHz ± 2KHz.

In the design of the tuners, it was found desirable to use the close tolerance, ± 1KHz types, K1 and K3. However, the manufacturers discontinued supplies of types K1 and K3, and offered only the ± 2KHz tolerance units, K2 and K4. In order to avoid any problems which may arise with the wider tolerance types, Standard Telephones and Cables immediately undertook to supply matched sets of three filters, two type K2 and one type K4 and these are normally supplied in a plastic packet.

By providing matched sets in this way, the only variation is that any given set may not be right on 455KHz. This is no disadvantage and readers may use these with every confidence.

Standard Telephones and Cables have pointed out that stocks of matched filters are available through normal distributors but they are not able to supply matched sets, to individual customers, over the counter at Liverpool. Mail orders, however, can be supplied from this address.

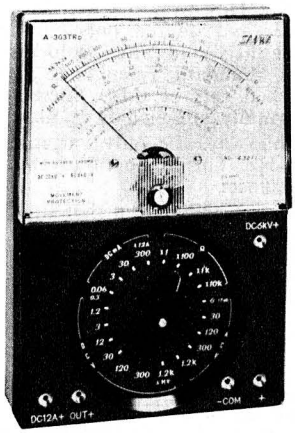
Unfortunately, although the correct filter types are called for in the parts list for October, the circuit diagram was not altered. Therefore, on the circuit, 2 x D455K1 should read 2 x D455K2 and D455K3 should read D455K4.

Another point which has brought queries from some builders, is the effect which is obtained when tuning across a strong signal with the selectivity switch in the wide position. Although reference has been made to this in the articles, it may need clarification. Due to the fact that the wide pass band shape is almost flat topped and the AGC (meter peaking) ceramic filter is introduced into the circuit, the AGC is only fully operative when the meter is at its maximum swing. When approaching this point from either side, the AGC is not fully effective, the volume will be higher, and there may even be a certain amount of distortion. This is normal, and the tuning, when properly peaked, results in optimum reception.

If this effect is found to be objectionable, it may be avoided by switching to narrow selectivity, tuning the wanted station, and then switching back to wide selectivity.

TEST WITH THE BEST

New from Sanwa A-303TRD—a medium-size circuit tester with a 44-micro-ampere meter movement.

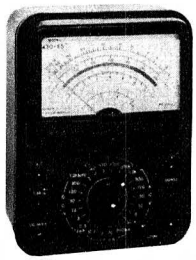


- Zener effect via silicon diode automatically safeguards the moving coil from burn-out. Also functions against pulse voltage in television circuit checking.
- Solid-state diode rectifier obtains stability measurement extending frequency coverage up to 100kHz for lower ranges.
- High voltage probe is available extra to align television circuits.
- As a Sanwa TR Series multitester, the specific LI and LV scales provided serve to check characteristics of semiconductors by reading current and voltage applied simultaneously with resistance.
- For better insulation and ruggedness, the front panel and rear case are moulded from plastics.

Measurement Ranges

DC voltage :	0.3V 1.2V 3V 12V 30V 120V 300V 1.2kV 6kV (20kΩ/v) 25kV (with probe)
AC voltage :	6V 30V 120V 300V 1.2kV (8 kΩ/v)
DC current :	60μA 3mA 30mA 300mA 12A (300mV)
Resistance :	Range - ×1 ×100 ×1K ×10K
	Midscale - 25Ω 2.5kΩ 25kΩ 250KΩ
	Maximum - 5kΩ 500kΩ 5MΩ 50MΩ
Load current (LI) :	60mA 500μA 60μA
Load voltage(LV) :	1.5V 1.5V 1.5V
Volume elvel :	−10∼+17∼+63dB
Accuracy.	Within ±2.5% for DC range up to 1.2kV.
	Within ± 4% for DC 6kV range.
	Within ± 3% for AC ranges.
	Within ±2.5% for ohm ranges.
Batteries.	1.5V×1 and 22.5V×1
Size.	170×116×59mm

430-ES Multitester



- Meter movement of 10 microamperes, doubly protected by silicon diode circuit and spring-backed jewel bearings.
- Common terminals for DC and AC current measurements. Two AC current ranges read on single scale because of equalized characteristics.
- Solid-state germanium diode rectifier.
- Flat frequency response up to 100kHz.

Measurement Range.

DC voltage :	0.3V 3V 12V 30V 120V 300V (100kΩ/V)
	1.2kV 6kV 30kV (with probe) - (16.6kΩ/V)
DC current :	12μA 0.3mA 3mA 30mA 300mA 1.2A 12A (300mV)
AC voltage :	3V 12V 30V 120V 300V 1.2kV - 5kΩ/V
AC current :	1.2A 12A
Resistance :	Range - X1 X10 X100 X10K
	Midscale - 40Ω 400Ω 4kΩ 400kΩ
	Maximum - 5kΩ 50kΩ 500kΩ 50MΩ
Volum level :	−17∼+63dB
Accuracy.	Within ±2% (10% for 6kV and above) fsd for DC voltage.
	Within ±2% fsd for DC current.
	Within ±3% fsd for AC voltage.
	Within ±2% of scale length for resistarce.
Frequency coverage.	50Hz-100kHz for AC 30V and below (±3%)
	10kHz for other AC voltage ranges.
Batteries.	Four 1.5V (UM-3) and one 1.5V (UM-2) dry cells.
Size & weight.	179×133×85mm & 1400 gr

SH-63TRD Multitester

- Protected by silicon diode circuit.
- Stabilized AC voltage reading by solid-state rectifier and frequency coverage extended up to 100kHz.
- Current loss minimized by high input impedance (20k ohms/volt for DC and 8k ohms/volt for AC).
- Standard HV probe of sealed-in 480-megohm resistor

Measurement ranges.

DC voltage :	0.25V 1V 2.5V 10V 50V 250V 1000V (20k Ω/V)
AC voltage :	1.5V 10V 50V 250V 1000V (8k Ω/V)
DC current :	50μA 2.5mA 25mA 250mA (250mV)
Resistance :	Range - X1 X100 X1000 X10000
	Midscale - 25Ω 2.5kΩ 25kΩ 250kΩ
	Maximum - 3kΩ 300kΩ 3MΩ 30MΩ
	Minimum - 0.5Ω 50Ω 500Ω 5kΩ
Load voltage:	1.5V 1.5V 1.5V -
Load current:	60mA 600μA 60μA -
Volume level:	−15∼+5dB for AC 1.5V range
	0∼+22dB for AC 10 volt range and up to +62dB
Accuracy.	±3% fsd for DC voltage & current
	±4% fsd for AC voltage (±6% for 1.5V range)
	±3% of scale length for resistance
Batteries.	One each 1.5V (UM-3) and 22.5V (BL-015) dry cells.
Size & weight.	160×103×64 mm & 730 gr approx.

U-50D Multitester

- Meter movement of 35 microamperes safeguarded by a protection circuit.
- Reading error eliminated by battery sheaths.
- Shunt adapter separately available.

Measurement Ranges:

DC voltage :	0.1V 0.5V 5V 50V 250V 1000V (20k Ω/V)
AC voltage :	2.5V 10V 50V 250V 1000V (8k Ω/V)
DC current :	50μA 0.5mA 5mA 50mA 250mA
Resistance :	Range - X1 X10 X100 X1K
	Midscale - 50Ω 500Ω 5kΩ 50kΩ
	Maximum - 5kΩ 50kΩ 500kΩ 5MΩ
Volume level:	−20∼+62dB
Accuracy.	±3% for DC and ohm ranges
	±4% for AC ranges
Batteries.	Two 1.5V dry cells (UM-3 or equivalent)
Size & weight.	131×89×41mm & 445 gr
Accessories available.	Shunt adapter — High voltage probe
	Clip adapter — Carrying case

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The Serviceman

SIMPLE FAULT — COMPLEX JOB

The above heading will be no mystery to regular servicemen. One spends a long period dismantling a piece of equipment, corrects the fault in a matter of minutes, then spends an equally long period putting everything back together. The story I am about to tell must represent just about the ultimate in this form of frustration.

This story was related to me by a colleague, who is by way of being something of a specialist in converting imported receivers — particularly American and Japanese — to operate on Australian standards. While it is not the kind of job I would deliberately go seeking, my colleague seems to have been able to organise his business so as to cope with them relatively painlessly. Not only has he acquired considerable experience in regard to the circuitry and mechanics of most of the popular overseas designs, but he has also tracked down various local importing agents who can supply spare parts, such as IF transformers, which might be needed for such conversions. As a result, he now has something of a reputation among his fellows, many of whom prefer to divert such jobs direct to him, rather than become involved themselves.

And I gather, from what he tells me, that the demand for this kind of work is increasing. His main customers are people who have just completed an overseas trip and who were unable to resist the temptation to buy a TV set, usually one of the portable variety, which are available at such attractive prices. Few of them stop to consider what is likely to be involved in converting them for Australian standards, or whether in fact anything of this nature will be necessary. Of those who do consider the problem, most seem to imagine that it involves nothing more than conversion for the local line voltage.

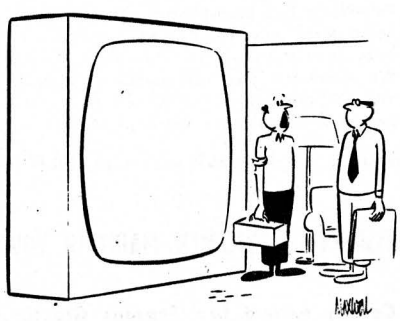
A couple of customers have even invested in colour TV sets, presumably in anticipation of the eventual advent of colour TV in this country. And, while it is no more difficult to modify these sets for local monochrome reception, I hate to think of the possible complications which will result if, as seems likely, Australia adopts some standard other than N.T.S.C.

But to revert to the more common monochrome receivers. These sets have several differences. They are designed for different channels, different video/sound frequency separation, different line frequency and different field frequency. I often wonder how many people would buy them if they were told of these differences. Fortunately, only the first two are really important. The line frequency, although different, is only 125Hz away from the Australian frequency, a negligible percentage at around 15KHz. It is normally well within the range of the automatic or manual adjustment.

The two field frequencies differ by a greater percentage — 60Hz must be reduced to 50Hz — but, in spite of this, one can usually cope with the situation with the panel control. At the worst, one might have to pad the circuit a little in the odd set.

The other two problems are more serious. The difference in the video/sound frequency separation — 5.5-MHz in Australia, 4.5MHz in U.S.A. and Japan—means that the sound IF system in the receiver must be retuned to the higher frequency. Sometimes this is possible simply by adjusting the cores, or fitting a different kind of core, and sometimes it means fitting new IF transformers. It is in the latter case that knowing where to go for replacement parts is as important as knowing what is required.

The problem of channel differences can be serious or not, depending on a number of factors. The original channels covered by Japanese sets approximate most of the Australian channels, but are sufficiently displaced in some cases as to necessitate either pruning individual coils or, in more difficult cases, having a tuner specialist supply and fit new coils to the biscuits.



"Tell me where you got it and I'll fix it for nothing." ("PF Reporter")

The extent of what needs to be done depends in a large measure on the district in which the set is going to be used and whether it is ever likely to be used in another district. On the basis of one particular district only, no more than four channels would normally be involved, and the chances are that some of these, at least, would need little or no modification. Thus one may not need to adjust more than one or two channels. If, on the other hand, the owner has ideas about moving around the country, and taking his TV set with him, then a much more comprehensive — and expensive — job would be required. I gather that most settle for the local channels.

It must also be realised that, even when all this is done, the performance of the set is likely to be inferior to that of a similar set designed for the local standards, for the simple reason that the latter would be designed to accommodate the wider bandwidth of our system.

More recently, I understand, a few travellers have become sufficiently aware of the problem to take a different approach. In buying such a set, particularly in Japan, they specify one designed for European standards. These, apparently, are readily available, presumably being designed for export. The European standards are closer to the Australian ones in regard to bandwidth and video/sound separation, thus virtually eliminating the need for any work on the IF system. On the other hand, the tuners do not cover our channels 3, 4, 5, and 5A. If these channels are needed, new coils must be fitted.

All this is rather incidental to the story I have to tell, but I felt that it was worth presenting, if only because it is some time since I discussed this problem and some aspects of it have changed.

So let us to the story with no more delay. It concerns one of these Japanese sets which my colleague was converting. It was a solid-state design, using several printed wiring boards, some of which had to be unscrewed from their mountings to provide access to others which needed modification. It was after the modifications had been made and most of the boards replaced that the trouble first appeared. When all but one of the boards, the video IF and detector board, had been remounted, the set was switched on for a brief check, leaving the last board connected but unmounted in case it was necessary to perform further work on the modified board.

At this point the set worked perfectly and, while it was still running, the last board was screwed into place. As this was being done the set suddenly exhibited an intermittent tendency to lose both picture and sound. These symptoms suggested two things; that the fault was almost certainly confined to the tuner or video IF section, since these were the ones common to both picture and sound, and that it was most probably in the board just screwed into place, since it appeared to have been brought on by the tightening of the mounting screws.

This latter theory was quickly confirmed by unscrewing the board and flexing it gently, whereupon the fault came and went in a completely pre-

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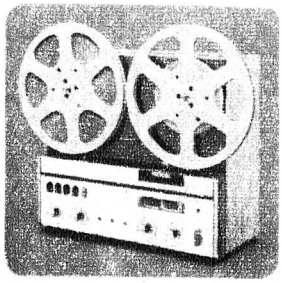

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Dual 1009F auto/transcription turntable fitted Shure magnetic cartridge. Kenwood TK250U solid state amp. 19 watts rms per channel plus multitude of features including Hi-Lo filters, separate tone controls, loudness tape monitor, etc., extreme versatility plus quality. Peerless 10" 3 way speaker system using 2 x tweeters, 1 x midrange, 1 x bass speaker and crossover unit in 2 cu. ft. enclosures and remarkable system. This complete outfit completely wired and including turntable base at $493.00.

Sansui 2,000 Tuner/Amp. 36 watts rms per channel superb quality, full control facilities, all silicon transistors. Dual 1019 professional auto/transcription turntable fitted Shure M55E Magnetic Cartridge. Goodmans 12" 3 way Speaker system with horn type midrange and tweeter in Sherwood enclosures. This superb system comes to you at $975.00.

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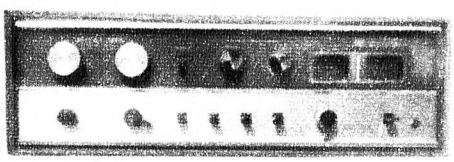

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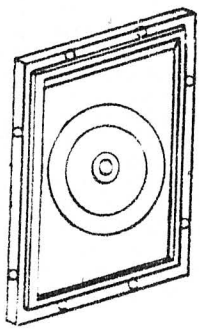

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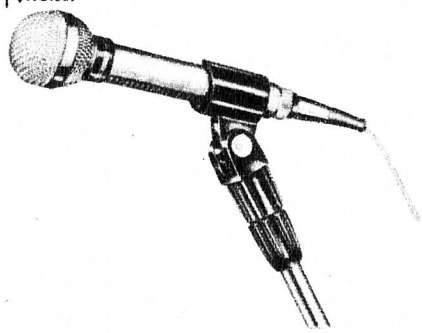

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dictable manner. The next question was, where on the board was the fault?

A CRO was brought into operation and the signal traced along the IF strip while the fault was induced. Everything seemed to be in order right up to the output of the second last IF, but disappeared somewhere between this point and the input to the video amplifier.

It was not possible to be more precise than this at this stage because the intervening components were enclosed in a metal shield can. This measured about one and a half by one and a quarter inches, and about three quarters of an inch high. It contained the last IF transformer, and all the components of the video detector stage. The can was held to the board by means of four stout lugs. These passed through slots on the board, were bent over, and soldered to the copper pattern on the underside.

To make the situation even more obscure, an equivalent area on the copper side of the board was covered by a metal shield. This was also held in place by four short copper lugs, bent over so as to raise the shield about 3/16in above the board. These four lugs were also soldered to the copper pattern.

At this stage it was considered that the most likely cause was a hairline crack in the copper pattern around this area. But to find it meant removing the metal shield. This was quite a frustrating job. The presence of four securing lugs on such a small plate meant that it was not possible to bend the plate enough to break any one soldered connection in one operation. The best that could be done was to melt the solder on one lug, drain off as much as possible, lift the lug by a small amount, and repeat this procedure with each of the remaining lugs in turn. Then, by going round all four lugs a second time, the shield was finally freed.

Not that this achieved very much, except in a negative sense, because the most detailed examination of the wiring pattern failed to reveal any suggestion of a hairline crack. And, while this was not conclusive proof — hairline cracks have been known to escape the most eagle eye — it seemed sufficiently conclusive to justify removing the shield can.

As with the shield plate, this was a frustrating job — only more so! Because the lugs had been bent over before soldering it was necessary to drain away as much solder as possible from each lug before any attempt could be made to straighten it. Then more solder had to be removed and another attempt made, being careful all this time not to damage the copper pattern or base material by applying too much heat. Eventually all four lugs were straightened and freed from the copper pattern, allowing the can to be lifted free.

And there was the trouble plain for all to see. Two components, the video detector diode and a shunt peaking choke were mounted upright on the board, adjacent to one another. In each case a pigtail from the top of the component was bent over, "U" shape, to complete the connection to the board. Each pigtail was bare and the layout such that they passed close to one another. At least, that's how they should have been. In fact, they were virtually touching and obviously had been touching when the set failed. After all the trouble it had taken to find the fault, the simple job of spreading the two wires apart was a complete anti-climax. However, my colleague did make the gesture of unsoldering one pigtail and slipping a length of sleeving over it. At least it wouldn't happen again.

Faults like this reflect little credit on the manufacturer. It is bad enough that the layout was such that a careless operator could assemble the components in such a potentially troublesome situation. But it was even worse that the section of the set should be so effectively sealed off that to get at it involved a very real risk of wrecking the printed wiring board. Surely manufacturers should recognise that no component or method of assembly can be regarded as one hundred per cent reliable and that, therefore, every part should be reasonably accessible for service.

And that a shield can, held on with four lugs, bent over and soldered, does not represent reasonable accessibility.

My next story concerns a fairly routine fault but is worth telling for a couple of reasons. One is that it was what might be termed an intermittent in reverse. Whereas the usual intermittent will not be apparent most of the time—and whenever a serviceman is present—this fault was in evidence most of the time but could be cured temporarily. And this leads to the second point. The owner, having discovered how to cure it, continued to use the set on this basis for some considerable time, without regard to the possible damage this might cause.

As the fault was presented to me it was a simple case of lost vertical deflection; a bright line across the centre of the screen. My first reaction was to nominate the appropriate valve; a 6BM8 with the triode functioning as the vertical oscillator and the pentode as the vertical output. Alas for my snap diagnosis, a new 6BM8 failed to have any effect. While the failure could have been due to any of several components in the vertical deflection circuit, I decided to check yoke continuity before delving into the innards of the chassis. Yoke failures are not common, but they happen often enough to justify a check when this can be performed so easily.

And that was where the trouble proved to be; a clear-cut case of an open circuit vertical deflection coil. But was it so clear-cut? A chance remark by the lady who owned the set set me thinking, and I asked a few pointed questions. Slowly, I pieced the whole story together.

It appeared that the first time the set had failed in this manner, the owner had left it running with the rather vague hope that it might come good of its own accord. Strangely enough, this is exactly what happened. After the set had been running for about half an hour, the line suddenly blossomed out into a full-size picture and continued to function that way until the set was turned off.

The next time the set was needed the owner took the precaution of switching it on about half an hour before it was wanted. Sure enough, the

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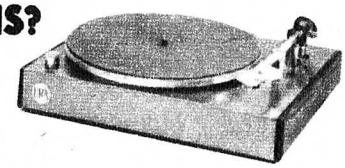

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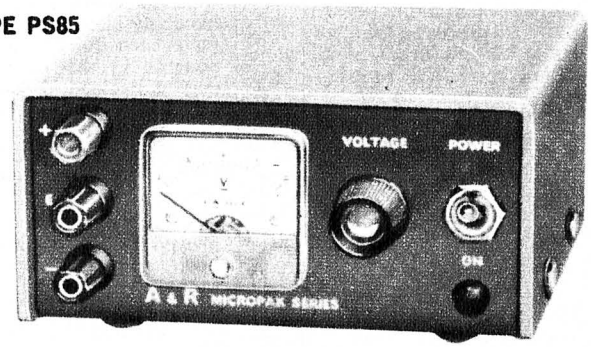

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same thing happened, the set coming good just before the wanted program was due to start. From then on, of course, this became standard procedure. After all, why call in a serviceman, when you can coax the set into operation in such a simple manner?

The only snag was that the time needed to get the set functioning slowly increased. First three-quarters of an hour, then an hour, and so on until, by the time I was called, it needed a full two hours "warming up" to get it into operation. Exactly how long this had been going on I was unable to discover, but I was able to work out that it had been several weeks at the least.

Unfortunately, it had not occurred to anyone to turn the brightness down during these warming-up periods, so the poor old picture tube screen had been working overtime along this one line. The result was inevitable; a distinct brown burn line across the centre of the screen. The only fortunate aspect of the situation was that the damage seemed to have been something less than total. While the line was quite obvious when the tube was not working, it was much less so with the picture on the screen. In fact, the owner had not been aware of its existence until I pointed it out.

Immediately it was pointed out, however, she wanted to know whether this meant the picture tube would have to be replaced. I probably could have scored the sale of a picture tube had I chosen to pitch a sufficiently convincing story, but I couldn't honestly convince myself that it was justified. So I assured the lady that it wouldn't damage the rest of the set. wouldn't blow up, and could continue working while ever the damage did not intrude on her enjoyment of the picture.

Naturally, I had to fit a new yoke. While I was doing this, I considered the likely reason for the intermittent behaviour of the faulty one. Presumably the open circuit was simply a microscopic break in one of the wires, of such dimension that it would close when the temperature of the yoke rose sufficiently. Such a temperature rise would be due to the natural warming up inside the cabinet, the heat from the picture tube heater, and the heat generated in the still active horizontal coil.

The reason for the increasing time needed to close the gap was almost certainly due to the small amount of metal erosion which occurred each time the two ends came together and completed the circuit. Ultimate complete failure was almost inevitable.

Still on the theme of "The Things People Do," this story from a colleague must rate some kind of a prize.

His outside serviceman, an experienced and reliable technician, had gone out on what should have been a routine, on-the-spot repair. Instead, he returned with the complete set, cabinet and all.

"What did you bring all that back for?" asked my colleague.

"Had to," was the reply, "It wasn't a valve and I couldn't get the chassis out of the cabinet."

"Why not?" asked my colleague, getting ready to blow his top unless the explanation was a good one.

"Can't get the knobs off," replied the technician, with an air of smugness which seemed to say, "And I'll bet you can't, either." Sensing that there was more to the situation than sudden insanity on the part of the technician, my colleague calmed down a little.

"All right," he said, "I'll bite. What's the joke."

"I'm not sure," was the reply, "but I think the knobs have been glued on."

"What!"

"Well, come and have a look."

Together they examined the situation. There was no doubt about it, the knobs wouldn't come off, and it did appear that they had been fixed in place with some kind of adhesive. Finally they had to smash a knob to get it off —and solve the mystery. Apparently the knobs had given some trouble by working loose, so the owner had decided to make a permanent job of it by fixing them in place with no less a preparation than "Araldite," a mixture guaranteed to mend a broken heart!

The upshot of it was that every knob had to be smashed before the chassis could be removed. Then a complete replacement set had to be obtained from the manufacturer, adding something like $4 to the final account. I imagine the owner will think twice before he tries that trick again.

In fact, he was lucky. Knobs belonging to many of the older TV sets are virtually unobtainable, and those of us who have to remove them are forever fearful that we will break one and create an extremely embarrassing situation.

And, to finish off, here is a reader's letter prompted by my group of humorous stories in the September issue.

I was reading your article in September's issue and chuckling over the strange customer complaints re telephone troubles. This brought to mind an odd one that occurred here in Hobart a couple of years back.

A telephone call came to Master Control at ABT2, the caller complaining that since his television set had been installed his water tasted funny. This was treated (not to the caller, of course) with a mixture of derision and astonishment and passed to the P.M.G.'s Department as the joke of the week.

Eventually a P.M.G. inspector called on the complainant — who lived in a remote beach-side suburb — to investigate. Sure enough the water did taste odd. A very brief look outside located the cause. The house was supplied with tank water and the antenna — a fairly large one — was mounted directly over the tank. The local seagull population found it a very convenient perch — need we say more.

Anyway, relocating the antenna improved the water, and probably the health of the family.

This, though, does go to prove that the most outlandish complaints by customers do sometimes have a basis in fact.

I enjoy your informative and interesting articles.

Yours faithfully,
N.A.B.

My only comment is to second Mr N.A.B.'s penultimate remark. As far as I'm concerned, no complaint is too outlandish to be dismissed without investigation. There usually is a basis in fact. ■

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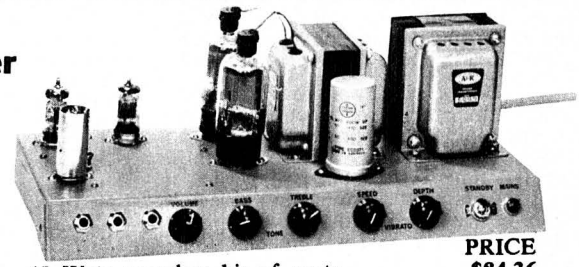

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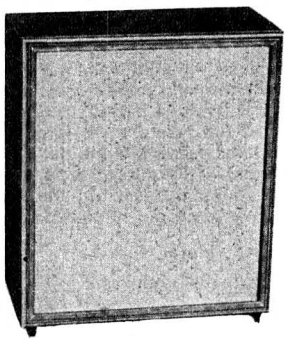

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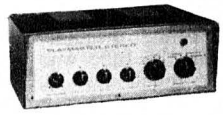

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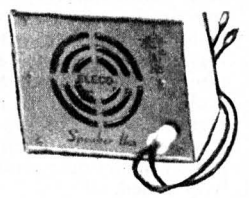

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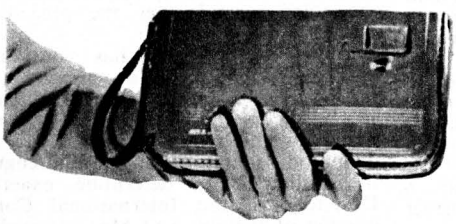

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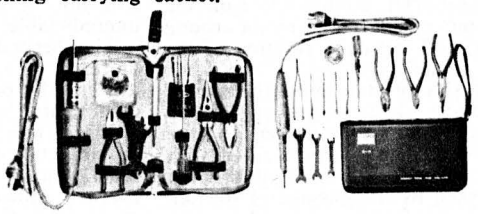

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CYCLES, SECONDS AND HERTZ

There has been a lot of discussion in everyday technical circles about the terms "cycles per second" and Hertz. In this article the author explains the background of the latter term and points out that it was adopted to resolve the ambiguity that had grown up around the seemingly straightforward expression "cycles per second".

By L. S. Spackman, ZL1AC*

It appears that there is still considerable confusion concerning the correct use of the term "Hertz" and this confusion appears to extend to those in high places (1). A Hertz, is by definition, one cycle per **SECOND**, but a cycle per second is not necessarily a Hertz. The use of the term "cycles per second," when defining frequency is largely meaningless unless it is properly qualified.

To understand Hertz and cycles per second it is necessary to understand time. Time and frequency are simply different expressions of the same phenomenon: time being the length of a cyclic phenomenon, and frequency being the number of events per unit of time. In other words, time is the reciprocal of frequency. Frequency standards or precise clocks are identical and, in fact, frequency standards are often called "clocks."

From earliest times, man has marked time by the three great natural periods: the annual rotation of the earth in its orbit around the sun, the monthly movement of the moon around the earth, and the daily rotation of the earth on its axis.

The earth's orbit around the sun is not a circle, but is an egg-shaped ellipse with the sun nearer to the wider part; also the earth is tilted with respect to the sun. Because of this the days, marked by the passage of the sun over the meridian, are not the same length. The days gradually increase in length, reach a maximum, and then decrease to a minimum, going through the cycle once each year. Only on two days during the yearly cycle is the sun over the meridian at noon. At other times, it differs by up to 17 minutes.

To obviate the need to adjust clocks daily, the mean or average period is taken, leading to Mean Solar Time. This is now called Universal Time or UT0.

As the earth spins on its axis, it wobbles in just the same way as did our tops when we were at school; the poles describing a great circle taking about 25,000 years per revolution. Superimposed on this is a number of smaller circles. However, the polar movement is not uniform, and the poles gyrate around to quite an extent (2). All of this affects the observed length of day and leads to partly corrected mean solar time or UT1.

In addition to these, the earth's daily rotation is affected by a number of other factors, such as seasonal melting of the polar ice caps which disturb its balance and other causes as yet imperfectly understood. Applying all these corrections leads to fully corrected universal time or UT2.

It will now be apparent that solar time is not a uniform time scale and the second of UT2 will differ in length from year to year, and even from day to day.

To overcome the difficulties of a variable time scale we use civil time, or co-ordinated universal time (UTC) for daily living. This is Greenwich Mean Time.

At the beginning of each year, a time scale is adopted which will correct for accumulated errors of the past year and give a time scale which it is hoped will not deviate too much from the unpredictable UT2.

The second of UTC is thus kept uniform for a full year but it may, and usually does, differ in length from other years.

It will now be seen that the measured time taken by an event will differ from year to year, making exact comparison difficult. Likewise a precise measurement of frequency will also differ from year to year if expressed in cycles per second of UTC or from day to day if expressed in cycles per second of UT2.

If we are going to define frequency in terms of cycles per second, then we must obviously state which second we are using. In the case of UTC time we must also include the year and for UT2 time we must state the date so that the necessary corrections can be applied.

Incidentally, although this has no bearing on the subject we are discussing, a brief mention of siderial time will be in order, particularly as many believe that siderial and solar time are the same. Siderial time, like solar time, is based on the revolution of the earth on its axis, but is referenced to a fixed star instead of the sun. The siderial year is about 20 minutes longer than the solar year, and there are 366¼ days in each siderial year. Siderial time can be defined more accurately than solar time; it is used by astronomers, but has little advantage over solar time for scientific measurements.

Prior to 1956 the International SECOND was based on solar time and was defined as 1/86,400th part of a mean solar day (UT0). The second of International time was thus substantially the same as the second of Universal Time.

In view of the variable length of the SECOND, in 1956 the International Commission of Weights and Measures redefined the SECOND as 1/31,556,925.974th part of the Ephemiris year 1900. The ephemeris year is the time taken for the earth to complete one revolution around the sun, but referenced to the sun.

As far as is at present known ephemeris time (ET) is uniform. The factor 1/31,556,925.974 was chosen so as to make the new international SECOND (ET) as close as could be determined to the average length of the solar second over the preceding 200 years (3).

However, the earth has continued to slow down, and at present the second of UTC differs by three parts in 10^8 from the ephemeris second. Although ephemeris time provides by definition, a unit of unvarying length, it is difficult to determine exactly. Despite this, the International Commission of Weights and Measures ruled that all scientific measurements and all radio and audio frequencies should, unless otherwise stated, be in terms of the International SECOND (ET) and not the second of UT.

The difficulty in making ET available was largely overcome as all Standard Frequency stations maintained their frequency in terms of ET. Similarly all National Standards of Frequency were corrected to keep ET.

The result of all this was that at the end of the last and the beginning of the present decade, there was considerable confusion, as both systems were in practical use. All precision frequency standards prior to this were arranged so that the oscillator frequency, usually 100KC, could be adjusted as required so that a clock driven by the oscillator kept time with UT2. As these units cost many thousand dollars, their owners were naturally reluctant to discard them. Unless the standard was within ground wave range of a standard frequency station, adjustment by using the standard transmissions was difficult because of the degradation resulting from reflection from the ionosphere. It was thus very difficult to maintain their frequency in terms of ET so they continued to use UT2 or UTC.

It was about this time that a writer in a German journal devoted to precise frequency measurement suggested that the confusion could be eliminated if the word "Hertz" was used to define frequency in terms of the international SECOND (ET). Although at the time the convention had no official status

***This article is reproduced by arrangement with the New Zealand publication "Break-In." The author, Len Spackman, is a New Zealand radio amateur who has made a special hobby of frequency measuring equipment. He is an industrial chemist by profession.**

it was immediately adopted and spread rapidly to other countries.

Hertz, therefore, meant cycles per second of ephemeris time, and cycles per second was assumed to be one or other of the solar time scales. As all radio and audio signals were required to be expressed in international time, the term Hertz therefore should apply to all these frequencies.

The frequency of national power distribution systems, being widely used to control domestic clocks had to be in terms of UTC. One frequently sees power line frequencies described as 50Hz or 60Hz, which is quite wrong as the frequency is in terms of civil time (UTC).

Therefore use Hertz for radio and cycles per second for power frequencies.

In 1955 (4) Essen and his co-workers, National Physical Laboratory, Teddington, U.K., developed an atomic frequency standard based on an atomic transition in the alkali metal, Caesium 133. Using this as a base, Essen was able to build a system of continuously running oscillators referenced to the Caesium resonator, and thus for the first time made available an absolute atomic clock and an atomic time scale.

It was fully expected that the time scale so produced would be as constant, at least, as ephemeris time with the advantage that it was more readily available. Anyone who was prepared to set up a caesium standard had available the basis of an atomic time scale which, in terms of frequency would be identical with all other atomic time scales.

As will be readily understood, this was a real break through. The U.S. Naval Observatory combined with the National Physical Laboratory to measure the frequency of the caesium standard in terms of ET and came up with the answer 9,192,631,770 C/S ± 20 C/S ET (5).

In 1964 the International Bureau of Weights and Measures again re-defined the international SECOND in terms of the atomic second, and assigned the value of 9,192,631,770Hertz for the transition between the two hyperfine levels F = 4, mf = 0, and F = 3, mf = 0 of the atom of Caesium 133 undisturbed by external fields (6) (7).

At the same meeting the International Bureau of Weights and Measures adopted Hertz as the official designation for one cycle per second of international (atomic) time. Hertz, therefore, now has the same status as Volt, Ampere or Ohm, and its use is mandatory. This applies even to ARRL and NZPO.

By now readers should understand the differences between cycles and Hertz. Let us now give a practical illustration.

Consider the nominal 10MHz transmission from WWV. If you have read the standard frequency section in the Call Book, you will know that the transmitted frequency is not exactly 10,000,000Hertz, but is offset (at present) 300 parts in 10^{10} and is low in frequency. This is the present difference between UTC and International time, and this is done so that the time signals transmitted will agree with UTC. This means that, instead of 10,000,000Hz, the radiated frequency is 9,999,999.7Hz. But the second of UTC is longer than the atomic second and, in one second of UTC, almost exactly 10,000,000 cycles will be counted. We can thus say that the nominal 10MHz signal from WWV is 9,999,999.7Hz or 10,000,000 cycles per second UTC. Note that the phrase "cycles per second" doesn't mean anything until we add the letters "UTC."

This example also illustrates the present difference between Hertz and cycles per second. From the standard frequency transmissions of WWV it is possible to obtain both International and UTC time, and by using the corrections which are broadcast hourly, UT2 as well.

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(1) Gorman, Kilohertz or Kilocycles: Break-In, May 1967, 122.
(2) Markowitz, Stoyko and Fedorov, Longitude and Latitude, Res. in Geophysics, 1964, 149.
(3) Essen, Hope and Morris, Measurement of Frequency (28) HMSO.
(4) Essen and Parry, Caesium Resonator as a standard of frequency and time, Phil Trans. A. 1957, 45.
(5) Markowitz, Hall, Essen and Parry, Frequency of caesium in terms of ephemeris time; Phy. Rev. Letters, August, 1968.
(6) Markowitz; The Atomic Time Scale, IRE Trans. 1962, 1-11, 3 and 4, 239.
(7) Barnes, Andrews and Allan; The NBS-A Time Scale —— Its Generation and Dissemination, IEEE Trans. 1965, IMI4, 4, 228.

The following additional references are recommended for those who may still be interested:

(8) National Bureau of Standards, Time and Frequency Service Bulletins and particularly Supplement No. 1.
(9) Merrill; Time and Frequency Standards—a Status Report, IRE Trans. 1960, 1-9, — 2, 117.
(10) Hudson; Some Characteristics of Commonly Used Time Scales, IEEE Proc. 1967, 55, 6, 815.
(11) Frequency and Time Standards, Application Note 52, Hewlett Packard Co., 1965.

EDITORIAL NOTE: "Electronics Australia" has for some time standardised on the use of the term "Hertz" for definition of frequency and has regarded it as a convenient substitute for cycles per second." As such, it has been used to describe the frequency of the AC power mains. We shall probably continue to use the term Hertz in all contexts, rather than become involved in fine distinctions which have a practical significance only in the realm of internation time and frequency standards. ■

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Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

MAGNETIC PRE-AMPLIFIER, EQUALISER

Mr L. Thew, 88 Braeside St, Wahroonga, N.S.W. 2076, submits details of pre-amplifier and equaliser unit suitable for coupling a magnetic pickup to a main amplifier.

This circuit of a magnetic pickup pre-amplifier, which I have developed and built, is a result of a search for a circuit with better equalisation and signal-to-noise ratio than those I have previously built.

The circuit is quite straightforward, comprising T1 as a common emitter amplifying and impedance matching stage; and T2 which raises the signal level to about 200mV output from a 5mV cartridge. This signal is then suitable for feeding into high level (crystal or ceramic pickup) inputs on the main amplifier.

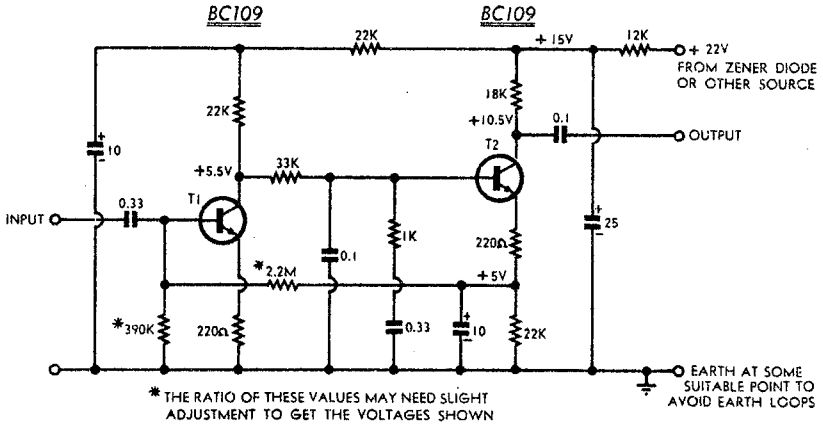
Input impedance at T1 is not less than 50Kohms which is suitable for the great majority of cartridges. This is due to the 220 ohm emitter resistor, which also provides a fair amount of negative feedback.

I have used a passive equaliser because a simple network gives a predictable 6dB per octave and it is easy to set up. The available compensation is not limited by amplifier gain, as may be the case with feedback type compensation.

The pre-amp has been used to drive the Unit Playmaster No. 4 and it gives very pleasing results. Output will drive this amplifier to full power output with most recordings. For higher gain a 12AX7 may be substituted in the main amplifier.

Pre-amplifier noise level at full gain (listening about one foot away from the speaker) is just perceptibly higher than with the Playmaster input shorted.

Editorial Note: The curve produced by this circuit follows the RIAA curve very closely, except that it does not provide the recommended roll-off at the bass end which should limit the bass boost to about 19dB at 20Hz, at which point the curve is substantially flat. This roll-off can be provided by reducing the size of the input capacitor (0.33uF) and output capacitor (0.1uF). In fact, by judicious selection of values the response could be made to fall below 20Hz; a useful feature where turntable rumble and/or acoustic feedback may be a problem.



PARLOUR GAME

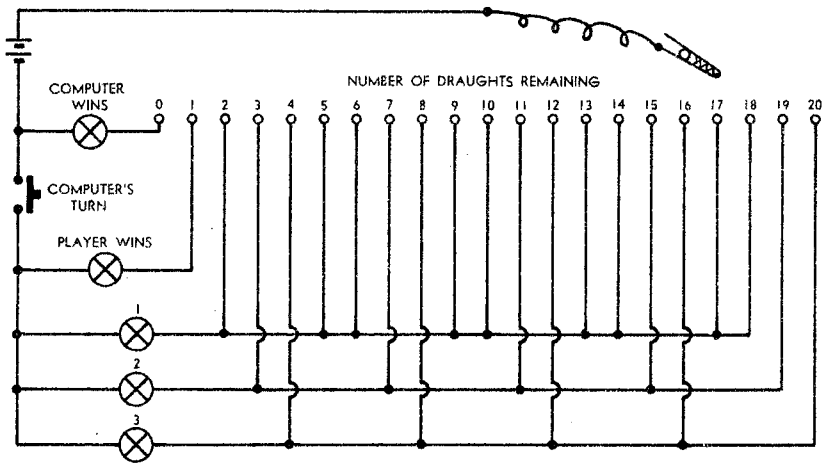
Mr M. Sayers, 18 Young Street, Mount Kuring-gai, N.S.W., 2080, describes an electronic version of a popular parlour game.

This circuit is of a very simple "computer" suitable for construction by younger readers. It will play the following game: Twenty draughts (or other objects) are laid out in a row and each player takes turns to remove one, two or three draughts. The object of the game is to force one's opponent to take the last draught.

It can be constructed in a small box with nails projecting from the top or front and wired together underneath as shown in the diagram. The crocodile clip is moved by the player, according to his own inclination when it is his turn, or according to the instruction issued by the computer when the "computer's turn" button is pressed. This is a simple loaded press button.

To start the game, the clip is attached to pin 20, indicating that there are 20 draughts still to be removed. A decision is then made—perhaps by tossing a coin — as to whether the player or the machine has first move. If the decision favours the player, he moves according to his inclination. If it favours the machine, the "computer's turn" button is pressed and the instruction acted upon.

In fact, the machine is unbeatable if it has first turn. It will usually win if the player has first turn, but it can be beaten.



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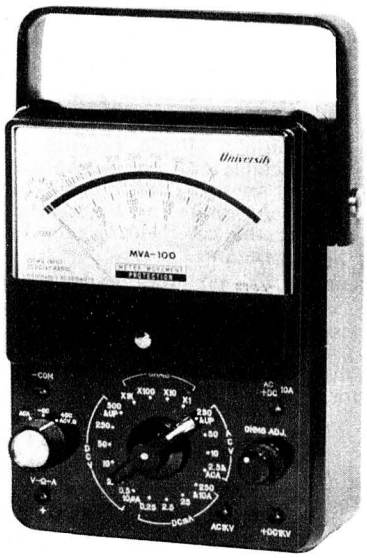

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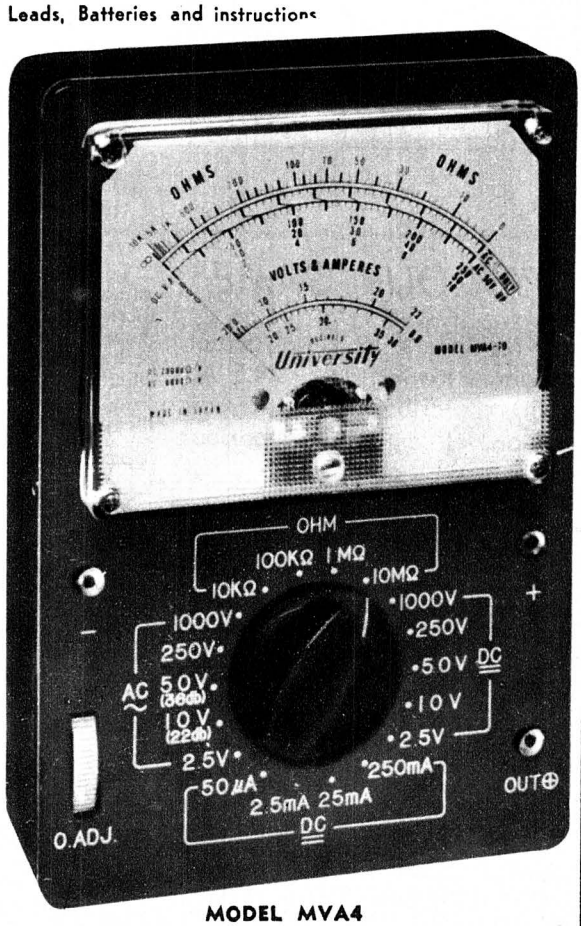

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MODEL CONTROL TRANSMITTER

Mr. P. Williamson, 11 Harley Street, Enoggera, Queensland, 4051, submits a circuit for a solid state radio control transmitter. It has its own tone generator, but has also been used with an external tone generator.

Here is a circuit of a radio control transmitter. It employs a Fairchild 2N3646 crystal oscillator operating in the common emitter mode, followed by 2N3643 class C power amplifier (PA) stage, feeding a pi tuned circuit. The PA is switch modulated by an AC128 transistor, controlled in turn by a multivibrator using two AC125s.

With a "Silvertone" receiver range is about 40 to 60 feet with 3 inches of antenna, and well out of sight (600yds plus) even with flat batteries and ¼-antenna up. At 600yds the receiver current was still rising to almost its maximum. With an "OS Pixie" receiver range with 3 inches of antenna is 150 feet and with full antenna is better than one mile (over open road).

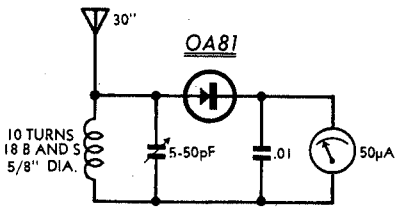
Modulation is accomplished by causing TR3 to switch on and off at the tone frequency of the multivibrator (TR1 and TR2). When TR1 is off (i.e., key switch open) TR3 is forward biassed to the negative line via the 10K resistor and 1K collector load of TR2. Hence TR3 is turned hard on. This supplies almost the full positive voltage (9V) to the PA stage and carrier is radiated continuously.

When the key is closed transistors TR1 and TR2 turn on and off alternately at the rate and mark/space ratio set by the 27K resistors and the two .047uF capacitors. When TR2 conducts the 10K resistor is virtually connected directly to the 9V positive line and TR3 switches off, thereby turning the PA off. (No supply voltage to TR4). When TR1 turns on, TR2 is off, so TR3 turns on (as before) and carrier is radiated. The result of all this is that the carrier is turned on and off at the multivibrator frequency.

This method of modulation is simple and provides a modulation depth close to 100pc. Even more important, it is economical of battery drain, a primary design requirement. Relatively high current drain is necessary in the PA stage to achieve a high RF input power, so power must be conserved in the rest of the circuit to give a reasonable battery life. The whole transmitter draws about 70mA when radiating carrier only.

A feature of the circuit is that it uses cheap transistors throughout. The two RF transistors can be obtained from Fairchild for $2.00, including postage. TR4 should have a small heat clip on it, as it gets warm without it.

Three versions of this unit have been built, all constructed on printed wiring boards fabricated by the photographic process. Other methods may be used but are not as neat. No shielding is necessary as long as the PA and oscillator coils are well apart, preferably at opposite ends of the board. The original board was 2½in by 3in.



Circuit of a simple field strength meter.

If any readers are interested I can supply them with an undrilled circuit board and a layout diagram.

The case is a two-piece folded aluminium type with dimensions of 6in x 4in x 2½in. The antenna is a 68in unit advertised in "Electronics Australia" by Homecrafts.

For economy, an Eveready 276P battery is suggested, but one version used a 9.6V nickel-cadmium battery of 225mAH capacity. Replace the dry battery when its voltage drops to around 7V, or when range begins to suffer, which ever happens first.

Coil L1 consists of 7½ turns of 24 B&S enamelled wire on a ¼in slug tuned former, tapped at three turns from the positive 9V end. L2 is three turns of flex over L1, in the same direction as L1. L3 is nine turns of 16 B&S wire, 5/8in I.D., close wound. The trimmers are Philips beehive type. The crystal is a 27MHz overtone unit.

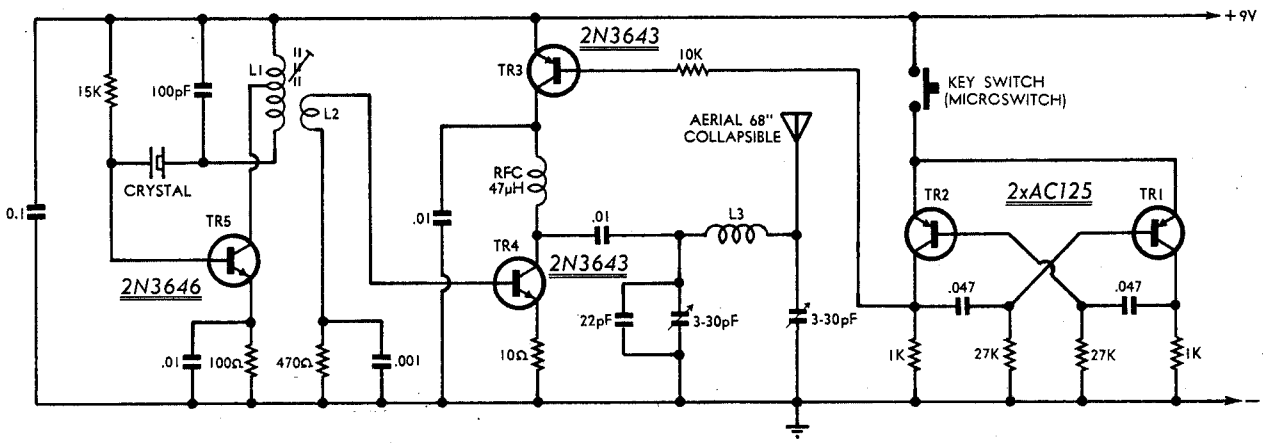
To tune the transmitter proceed as follows. Position the oscillator slug half way out of the former, and set the trimmers to their mid position. Connect a 6V 50mA lamp between the 9V rail and the antenna. Connect a 100mA meter in series with one of the battery leads.

Adjust the slug for maximum current drain. If the current drain is much less than 70mA, say 25mA, the oscillator is not functioning and the 100pF capacitor across L1 may have to be changed. Assuming normal current drain, the lamp should now be alight, or very close to it. Adjust the trimmer in parallel with the 22pF capacitor for maximum brilliance, then adjust the other trimmer similarly. Switch the transmitter on and off several times to check that the oscillator starts reliably every time. If it does not, back off the slug half a turn and check again. (The oscillator coil tuning will be very broad.)

Disconnect the bulb, extend the antenna fully and, with one hand on the case, adjust the trimmers for maximum output as shown on a field strength meter. (If you cannot borrow one of these, the circuit of a simple one is included.) Having peaked the trimmers, press the tone key. The reading on the field strength meter should drop to about half its previous reading. This indicates that the tone generator is working and modulating the carrier.

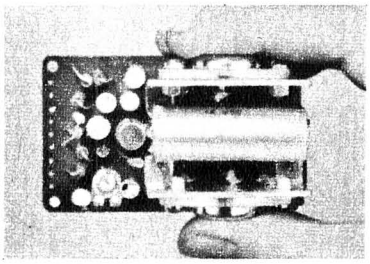
I have also used this transmitter with a five transistor pulser for pulse proportional control, and another version with high stability audio oscillators for use with multi-channel reed receivers.

If any reader would like to correspond with me about this transmitter, they may write to me at the address at the beginning of this article. I would welcome any suggestions readers may have for improving the circuit.



Circuit of the complete transmitter. Tone modulation is by means of the multivibrator involving TR1 and TR2. With key up, an unmodulated carrier is transmitted; with key down it is tone modulated close to 100pc.

Sinclair products for the electronic constructor—



Z.12 INTEGRATED 12-WATT HIGH FIDELITY AMPLIFIER

Technical specification

Output: Class B, ultra-linear, with generous negative feed-back.

Output Power: 12 watts R.M.S. continuous sine wave (24 watts peak); 15 watts R.M.S. music power (30 watts peak).

Frequency Response: 15 to 50,000 c/s, ± 1dB.

Input Sensitivity: 2 mV KΩ.

Signal to Noise Ratio: Better than 60dB.

Output Impedance: Suitable for 3, 7.5 and 15 ohm loudspeakers. Two 3 ohm speakers may be used in parallel.

Power Requirements: 6 to 20 volts D.C. or Sinclair PZ.4 Mains Power Supply Unit.

Quiescent Current Consumption: 15mA.

Size: 3in x 1⅛in x 1⅛in (7.6 x 4.45 x 3.2cm).

Weight: 3oz (85gm.).

Ready Built and Tested with Manual, **$13.60,** plus sales tax.

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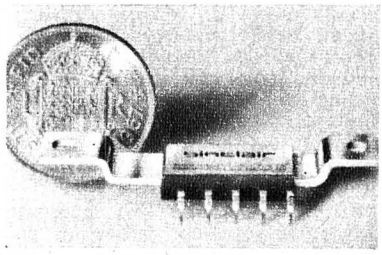


IC.10 INTEGRATED CIRCUIT 10-WATT AMPLIFIER

Specifications

Output: Class AB. 10 watts peak, 5 watts RMS.

Frequency response: 5Hz to 100kHz ± 1dB. Total harmonic distortion less than 1% at full output.

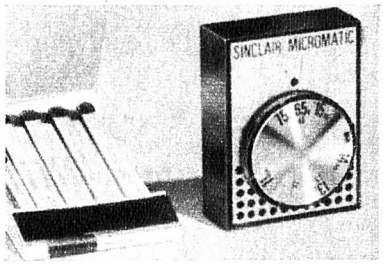
Power gain: 110dB (100,000,000,000 times) total.

Supply voltage: 8-18 volts.

Sensitivity: 5mV. Input impedance adjustable externally up to 2.5m Ω for above sensitivity. Size: 1in x 0.4in x 0.2in.

Circuitry: 3 transistors in pre-amp; 10 (including two power output) in power amplifier. Both sections are d.c. coupled, and a high level of negative feedback is applied over all. With a transistor cut-off greater than 500mHz, the pre-amp can be used as an RF or IF transformer and the whole IC.10 used as a radio receiver without the need to add further transistors.

Price, including application manual, **$9,** plus sales tax.



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Technical specification

Size: 1 13-16in x 1 7-16in x ½in (46 x 33 x 13mm).

Weight including batteries: 1oz (28.35 gms) approx.

Transistors: High gain silicon types.

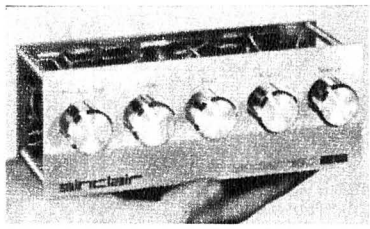
Circuit: Five stage reflex.

Aerial: Self-contained ferrite rod.

Earpiece: High-fidelity magnetic type for best possible quality.

Battery requirements: Two Mallory Mercury Cells, type RM 675, giving extra long working life.

Complete Kit with Instructions. **$7** plus sales tax.



STEREO 25 PRE-AMPLIFIER

Technical specification

Performance figures obtained from using the Sinclair Stereo 25, two Z.12's and a Z12 Power Supply Unit. Sensitivity for 10 watts into 1.5 ohms load per channel. Mic.: 2mV into 50 K ohms. Pick up: 3 mV into 50 K ohms. Radio: 20 mV into 10 K ohms. Frequency Response (Mic. and Radio): 25 c/s to 30 kc/s ± 1dB extending to 100 kc/s ± 3dB.

Equalisation for P.U.: Correct to within ± 1dB on RIAA curve from 50 c/s to 20 kc/s.

Tone Controls: Treble + 12dB to —10dB at 10 kc/s. Bass +15dB to —12dB at 100 c/s.

Size: 6½in x 2½in x 2½in (14.5 x 6.3 x 6.3cm) overall, plus knobs.

Finish: Front panel in brushed and polished solid aluminium with solid aluminium knobs. Black figuring on front panel.

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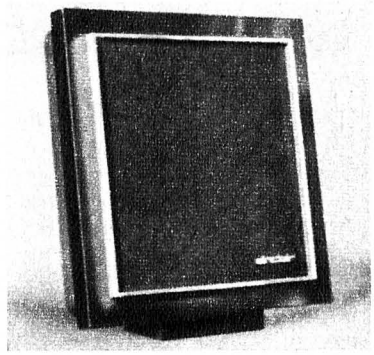

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SPEAKER GAIN CONTROL AND CONTOUR NETWORKS

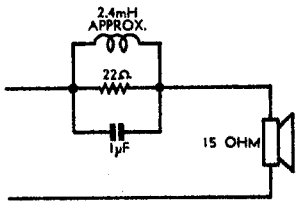
Mr. H. Swan, Bulimba Hostel, 50 Brisbane St., Bulimba, Queensland, 4171, submits circuits for constant impedance gain controls for use in voice coil circuits, and for a speaker contour network to smooth the response of a peaky speaker.

The gain control was developed to control the volume of a pair of remotely located stereo speakers operating from a Pye stereogram. Constant impedance control was decided upon as I was not certain of the reaction of the input transistors to variable loads. Also, a four-year warranty had to be considered. The fact that I had a two-pole, five position switch on hand settled matters. The volume is dropped in 3dB steps. Standard ¼W resistors were used. The suggested versions for 8, 4, and 2 ohms might be better with heavier resistors.

(Editorial Note: In the case of the lower impedance systems — particularly the 2 ohm system — resistance losses must be considered. The cables should be kept as short as possible and made as heavy as possible, while the switch should be a good quality unit in which contact resistance will be consistently low.)

The second idea is for a speaker contour network. This started when I was given a Mullard Mini Speaker enclosure. Not having the spare cash to buy a 6WR and a tweeter I decided to check how things would sound with the MSP 6TAX twin cone speaker.

Results were not bad, but sounded

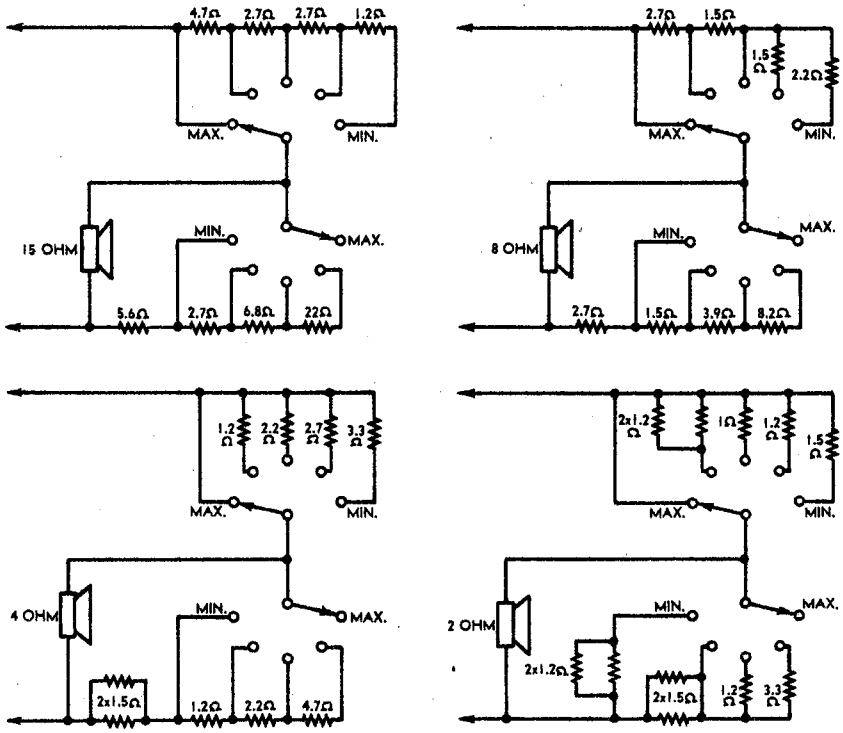


A contour network to control a peak in the 3KHz region.

a bit strident due, apparently, to the usual rise in output in the 2KHz to 4KHz region. Thus I decided to try an idea suggested in the May 1968 "Electronics Illustrated" (page 65), a damped LC network, resonant about the middle of this range, in series with the speaker.

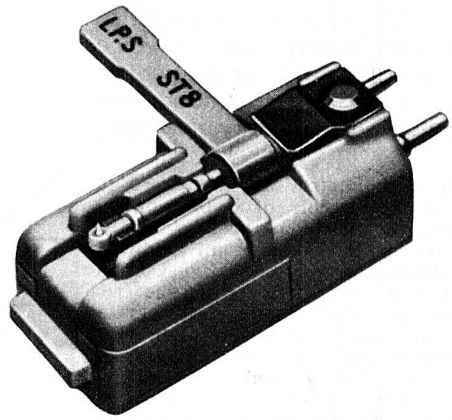
My coil former was 1¼in diameter and 7/8in wide. (Actually, it was a plastic spool that had held Yasaki insulation tape.) On this I wound about 160 turns of 16 gauge B&S enamelled wire. Inductance measured about 2.4mH.

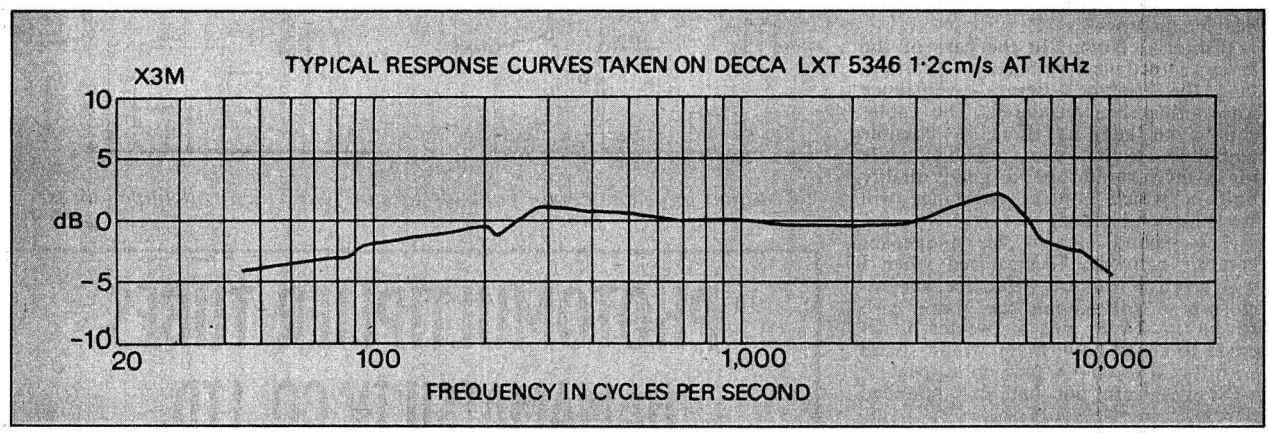
The speaker sounds very much smoother with this network. In fact, there is not much to choose between it and a Rola 8CMX fitted in a Briggs type drainpipe enclosure. The latter is somewhat fuller at the bass end, but there is little difference higher up. ◘



Constant impedance gain controls to suit four voice coil impedances.

With a BSR X3M 'compatible' cartridge, almost any mono record playing equipment can take stereo records (without damaging them)





Why compatible cartridges?

An increasing number of record companies are now making stereo LP records only.

Until now these records could not be played on a mono player without distortion and damage to the records.

When playing stereo records the stylus tip moves vertically and horizontally following groove contours. Mono records have grooves which only move the stylus horizontally so old mono cartridges will not allow vertical movement of the stylus. Playing stereo records with old mono cartridges will damage the vertical component of the groove irrevocably.

The X3M 'compatible' cartridge, designed and perfected by BSR, is the answer to this problem. For a small outlay it allows you to play both stereo and mono records without harming either. Retail price, $6.00.

TECHNICAL DATA X3M

Output:	350 mV ± 2 dB
1 KHz test record Decca LXT 5346 at 1.2 cm/s	
Frequency Response:	See typical curves above
Dynamic Compliance:	
Horizontal	3.0 x 10^{-6} cm/dyne (±20%)
Vertical	1.0 x 10^{-6} cm/dyne (±20%)
Equivalent Capacity:	800 pF
Nominal Recommended Loading:	2 M. ohm 100 pF
Stylus Pressure: depending on pick-up arm	4-6 grammes
Measuring Temperature:	20° C 68° F
Colour:	Beige

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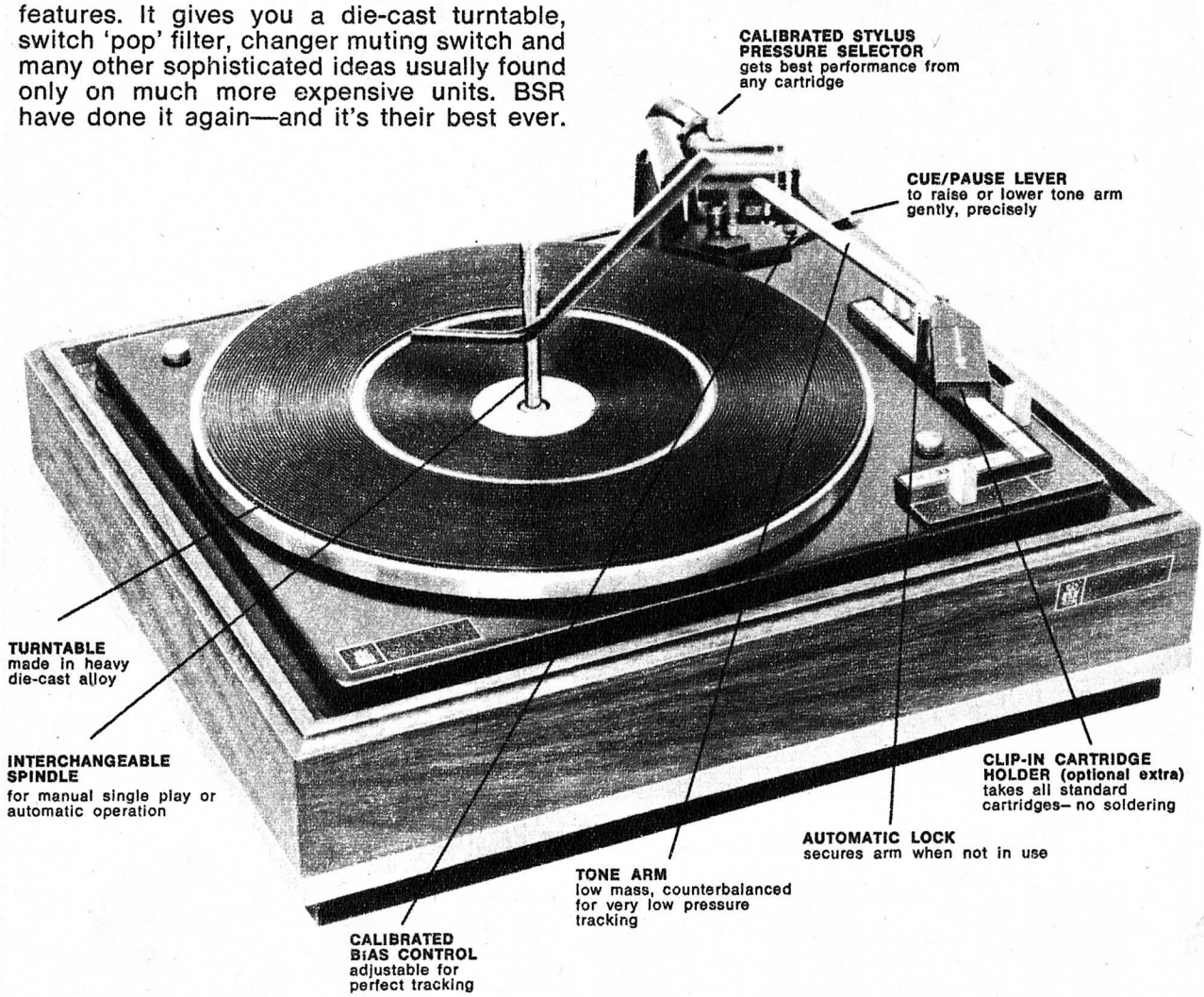

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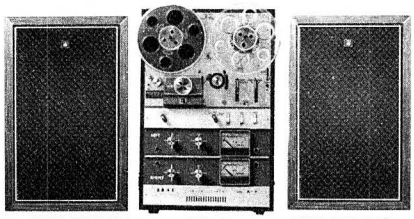

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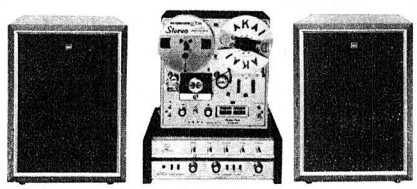

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AUDIO TOPICS

ONE STRAY WIRE: TWO DEAD TRANSISTORS

Transistor power amplifiers are notable for their compactness, their relatively modest temperature rise, their potentially high power output and low distortion. But they have one very disturbing feature — a tendency for the output transistors to fail if the output load is shorted or made too low in value. Why is this so and what precautions can be taken against it?

The problem is encountered all too frequently in two very common situations:

The first is in a hi-fi shop or in the home, where the person concerned is involved in a comparison between loudspeaker systems, experiments with cross-over networks or simply observing the effects of a change in loudspeaker phasing. One stray strand of wire is enough to create a short-circuit and, by the time the owner stops turning up the volume control and realises that a particular channel is not working, the damage is done. Two output transistors have developed internal shorts and need replacing, with all the usual involvements of type, time and money.

The second situation involves guitarists, the high-powered amplifiers they seem to favour and their habit of trying out one another's loudspeaker systems — always at maximum volume. The risks of a short-circuit are present, as ever, but there is also a possibility that they may fail to notice that they are connecting to an amplifier a system which has only a fraction of the intended load impedance. The result can be the same — failure of the output transistors.

In all these situations — showroom, home or stage—the basic cause of failure is excessive peak current through the output transistors when operating, with input signal, into a short-circuit or an abnormally low value of load.

One may well ask why transistors show this tendency and why they are apparently much less tolerant of abnormal load conditions than valves.

In fact, valves did have their share of troubles, particularly following the introduction of output tetrodes and pentodes. In this case, the problem had to do not with peak currents but with peak voltages.

At the higher frequencies, loudspeaker impedance normally rises far above the nominal value and, under these conditions, a loudspeaker/transformer combination presents to a valve output stage a load which represents a high inductive reactance. When the output valve (or valves) have a high internal impedance, high frequency signal currents can set up across the output transformer primary winding very high peak voltages. These, added to the already substantial plate supply voltage, can reach a total value likely to stress valve base and/or socket insulation.

Operating such a stage with the loudspeaker accidentally disconnected is— or was—an even more certain way of invoking trouble.

The classic example of a valve prone to failure in this respect was the all-metal 6L6 which, in the typical circuitry of the day, could easily create a peak voltage sufficient to set up an arc between plate lead and shell. Once started, that was that.

To counter the problem, it became common practice to connect a resistor and capacitor in series across the output transformer primary winding, the values being chosen to limit the circuit impedance at high frequencies to a safer value, without affecting too much the high frequency response of the system.

Subsequently, designs turned to the use of negative voltage feedback around the output stage, which had the effect of reducing the apparent impedance of the output stage and also the magnitude of the peak voltages which it could develop across the output circuit under conditions of high load or no load. In fact, modern well-designed valve-type feedback amplifiers can be normally driven, with no load, with negligible risk of voltage breakdown.

Valve-type amplifiers have never been very prone to damage by operation into a short-circuited load.

This is partly due to the fact that valves are generally and comparatively high impedance devices, not too easily provoked by the load conditions into delivering a self-destructive output current.

Secondly, shorting the output terminals of a valve amplifier does not present a load of zero ohms to the output valve anode(s). There will always be a minimum value of load contributed to by the "transformed" resistance of the secondary winding, the actual resistance of the primary and the leakage reactance.

To be sure, output valves, driven hard under "shorted" conditions may be severely stressed and may exhibit a sharp heat rise, but the limiting factors already mentioned, plus the thermal inertia and the tolerance of valves to heat effects, will generally delay the onset of damage long enough for corrective measures to be taken.

With transistors the situation is

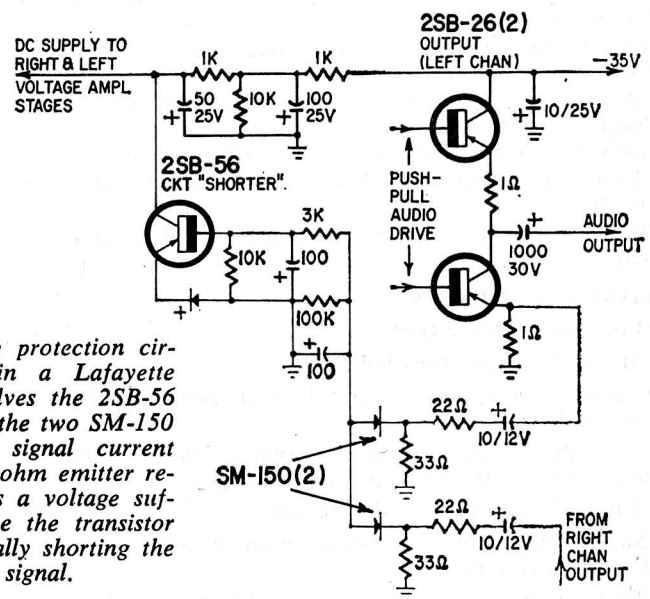

Figure 1: The protection circuitry used in a Lafayette amplifier involves the 2SB-56 transistor and the two SM-150 diodes. High signal current through the 1-ohm emitter resistor produces a voltage sufficient to make the transistor conduct, virtually shorting the input signal.

With transistors the situation is

Dual

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*Low mass tubular type.

*Magnesium tonearm head.

Tonearm dynamically balanced in all planes. Does not require critical levelling.

Elastically-damped tonearm counterbalance with thread adjust. Braked to prevent slippage.

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*Advanced design Continuous-Pole motor maintains constant speed within 0.1% even when line voltage varies beyond ±10%.

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Dynamically balanced platter of non-ferrous alloy, weighs over 4 pounds.

Concave anti-static platter mat provides support of records at maximum diameter, prevents slippage of badly warped records.

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*Dimensions: 12¾" x 10¼", 6" clearance above and 3" below mounting board. 1" clearance at rear and right for cabinet installations.

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quite different. Firstly, output transistors are relatively low impedance devices in the sense that, with drive and operating into zero or an abnormally low load, they can pass potentially destructive peak currents.

Another point is that the active area of a transistor is extremely small and, despite provision to disperse the heat of normal operation, temperature rise in the junction area can be sudden and intense under overload conditions.

The temperature rise may be sufficient to cause immediate and permanent destruction of the junction(s) or it may trigger a thermal runaway condition which can produce the same ultimate result.

Either way, the operator of the equipment may have little warning that anything is amiss, and little or no time to take corrective action. The amplifier goes dead and stays dead!

In the first wave of transistor amplifiers, the mortality rate of output stages was fairly high and all concerned learned some of the more obvious lessons the hard way. Manufacturers learned that the time-honoured idea of gripping loudspeaker leads under a screw-head left too big a chance for stray ends of wire to touch the adjacent screw or the chassis metal. Users learned that warnings about careless loudspeaker connections meant something.

Over and above this, however, a lot of attention has been given to protecting the output stage automatically against improper operating conditions or accidents of one kind and another.

The most obvious resource has been to the use of fuses in two main positions:

(1) In series with the loudspeaker output terminals, so that the abnormal signal current which would flow through an unduly low value of load will automatically "blow" the fuse and open the circuit.

(2) In series with the power supply to the output stage so that it will remove the voltage in the presence of a sustained abnormal current.

In general, fuses are far from being a satisfactory answer to the problem. Of necessity, they have to be selected so that there is the smallest possible margin between the normal current and the current at which the fuse will open. Due to tolerance and fatigue problems, this leads easily to a situation where fuses open spontaneously under high but acceptable signal current peaks and the amplifier gains a reputation for blowing fuses. Furthermore, if the fuses are replaced by types having a high rating, either by intent or accident, any protection that they might offer disappears forthwith.

In any case, not even fast-acting type fuses have been able to offer the kind of protection that has been necessary for power transistors under gross overload conditions. Investigations have shown that destruction of a transistor may be complete within a few microseconds after a gross failure situation is introduced.

No practical fuse can operate anything like as fast as this.

The same remarks apply to circuit breakers which have been employed by some manufacturers. These pose less of a nuisance than fuses, in that they can be reset after operation. But, like fuses, they are far too slow in their action to afford protection against a catastrophic overload condition.

In the June, 1965, issue of "Radio-Electronics," Peter E. Sutheim discussed some of the protection circuitry which was then being incorporated into American-designed transistor power amplifiers and what follows is a condensation of portion of this article, which will serve to illustrate a variety of typical approaches.

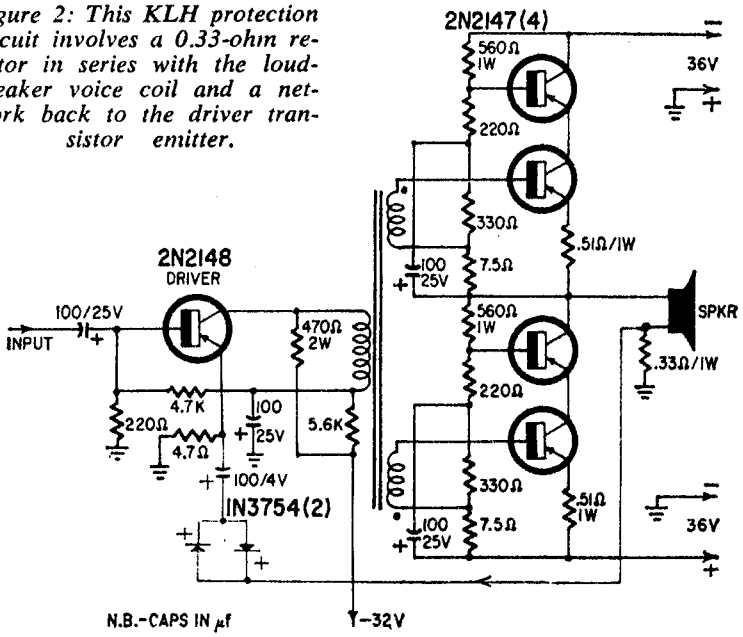
The Lafayette circuit shown in figure 1 amounts to an electronic "shorter" rather than a "breaker." The audio signal current in each output stage flows through the 1-ohm emitter resistor of the bottom transistor of each stage. (Only one channel is shown; both share the same protection circuit.) This resistor therefore produces an AC voltage drop proportional to the voice coil current. The voltage is rectified into a negative DC voltage which is applied, after filtering, to the base of a PNP transistor. The emitter of that transistor is grounded through a silicon diode, and its collector goes to the power supply point for intermediate amplifier stages.

If one or both of the amplifier's output stages are working harder than they should (as they would if driven to severe overload, or if the speaker lines were shorted), the current through the 1-ohm resistor is greater than it would be during normal operation, and the signal drop across it is higher. Hence the rectified negative DC is also higher — high enough to bias the protective transistor into conduction as it overcomes the threshold voltage of the diode in its emitter.

As soon as the protective transistor conducts, it practically shorts the intermediate-amplifier supply voltage to ground. This kills the drive to the output transistors. The time constant built into the R-C network between the rectifying diodes and the protective transistor makes the whole operation cycle on and off about twice per second until the short or overload is removed. This can go on indefinitely, according to the manufacturer, without harm to any part of the amplifier.

A system used by KLH and illustrated in figure 2, appears to work well. A 0.33-ohm resistor in series with the loudspeaker voice coil "samples" the signal output current and produces a voltage drop. From the "hot" end of

Figure 2: This KLH protection circuit involves a 0.33-ohm resistor in series with the loudspeaker voice coil and a network back to the driver transistor emitter.



that resistor there is a negative feedback loop back to the emitter of the driver stage, through two parallel back-to-back silicon diodes. These, like all semiconductor diodes, have a small threshold voltage (usually about 0.7 volt) that must be overcome before they can conduct in the forward direction. Until then, they are effectively open circuits.

This means that the loop is just not there at all until the AC "sample" is great enough to exceed the threshold voltage of the diodes. When the amplifier's output current rises above the expected normal maximum, the diodes conduct and throw heavy negative feedback around the last two stages, removing almost all the audio drive to the output transistors.

While this circuit has the advantage of simplicity, some engineers argue that it must introduce distortion on peaks as the diodes begin to conduct.

A simple and fairly effective method used in a Knight (Allied Radio) transistor amplifier combines overload protection with thermal stabilisation. The output circuit (figure 3) is a balanced, single-ended-push-pull class-B "half-bridge" circuit. The usual emitter resistors (usually about 0.27 to 0.68 ohm) have been replaced by selected 6-volt tungsten-filament lamps. They have a positive temperature coefficient (their resistance increases with temperature), so that as current through each output transistor increases and the lamp filament gets hotter, circuit resistance increases and tends to oppose the rising current. At the same time, increased drop across the filament cancels some of the base-emitter forward bias, helping to hold down collector current. This amounts to degenerative DC feedback and helps keep the output stage stable with changes in ambient temperature, sustained high signal levels and changes in power supply voltage.

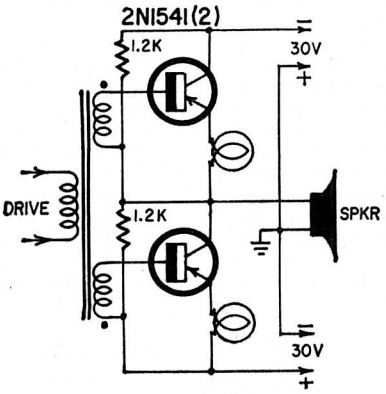


Figure 3: Some Knight amplifiers have provided carefully selected lamps in series with the output transistor emitters. Their high positive temperature coefficient combats any moderately high current condition, but the lamps will act as fuses if the condition becomes gross.

The lamps' thermal characteristic protects the output transistors against mild overloads. In case of a serious overload, the lamps will burn out, just like fuses, only faster — in about 70 milliseconds, which is claimed to be fast enough to protect the alloy-junction output transistors used.

A straightforward and very successful approach has been used by Schober in a 40-watt mono amplifier designed for electronic organ installations, where a sudden failure could be most embarrassing. It is diagrammed in figure 4.

A 0.3-ohm 10-watt wirewound resistor is in series with the speaker. Also in series, in the other speaker-lead, is a 0.24-ohm resistor, the pick-off point for a current-feedback loop to the driver transistor's emitter. These resistances, with the 0.51-ohm emitter resistors in the lower transistor of each series pair, help to hold down the maximum current that can flow through the transistors in case of a short across the output with a high signal current to the output stage.

Furthermore, as signal current increases, so does the negative current feedback to the driver, which tends to keep the drive (signal) current down to safe levels.

The system is foolproof except when the output transistor junctions are already near their maximum temperatures. Then a further overload may be enough to push them over the brink to destruction.

At least one manufacturer (Eico) is unimpressed by the case made for output stage protection and claims that a really foolproof system would typically add $20 to the end-price of a typical stereo amplifier. They draw attention to a paper by an RCA engineer, M. S. Fisher, "Protection of Transistors in Class-B Audio Output Stages." (I.E.E.E. Transactions on Broadcast and Television Receivers, Vol. BTR-10, No. 3, Nov. 1964.)

This paper points out that the immediate cause of all transistor failure in this kind of circuit is too much current, whatever may have initiated the trouble (shorted output, high transients, etc.). Then: "Destruction of the transistor may occur in a few microseconds or less after the failure mode is initiated."

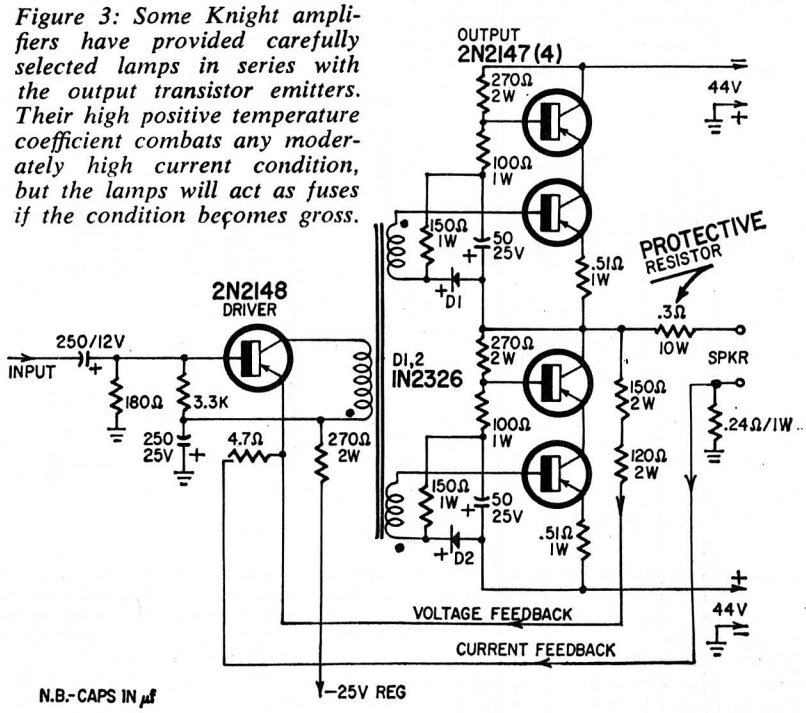


Figure 4: In this Schober electronic organ amplifier a series resistor makes it impossible to put a dead short across the output transistors. In addiion, negative feedback reacts to the voltage across, and the current through, the output circuit.

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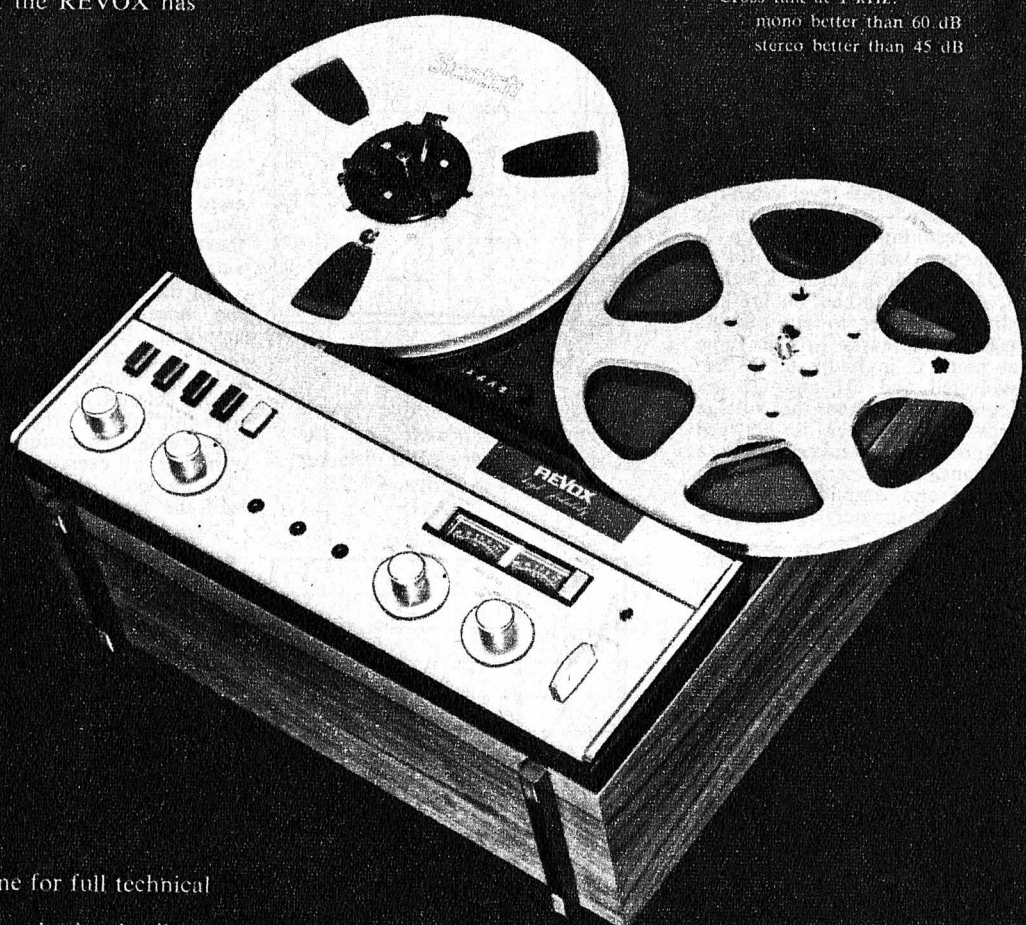

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The writer goes on to say that simple circuits can limit the drive signal or sense a too-low load impedance, but that is not enough. "The protection circuit should limit maximum transistor current . . . To be reliable, the circuit should react more quickly than the fastest rise time of current expected. Current limiting should begin within a few microseconds after a failure mode is initiated, and the power supply should be disconnected within 100 microseconds after limiting occurs."

No fuse at a price within reason can do that. The only answer so far has been an ingenious — but comparatively costly — "electronic circuit breaker" described in the same paper (see figure 5). It uses three transistors, one of which is a power transistor and requires some heat-sinking, a diode, five resistors and a capacitor. Its action is ideal, though, as shown by the curve in figure 7.

Normally, when total current through R1 and Q1 is less than 3 amperes, the circuit behaves like a low resistance in series with the supply line to the output stage. Q1 and Q2 are held in saturation by the bias developed across R3. Q3 is off because the voltage across R4 is not high enough to overcome the offset (threshold) voltage of Q3 and the 1N3754 diode in the base circuit.

When the current drawn from the power supply through R1 and Q1 reaches a predetermined level (about 3 amps in this case — point B on the curve), the resulting voltage drop V produces enough voltage across R4 to turn on Q3. The drop across R3 then increases, reducing the bias on Q1 and Q2 so that they start to cut off. As the voltage V increases to the value shown at point C in figure 6, Q3 becomes saturated and Q1 and Q2 are cut off completely. When the voltage drop across the breaker is between points C and D, the breaker acts as a high resistance in series between power supply and amplifier. All this happens in approximately 100 microseconds (figure 7).

It will stay that way as long as the drop across R1 and Q1 remains at point C (figure 7) or higher. A bleeder must be used to keep pulling current through the breaker, otherwise it will continually reset itself and destroy the output transistors anyway. The proper approach is to make reset impossible until the power supply has been turned off.

For the most popular output circuit, four separate breakers of the kind just described are necessary for complete protection!

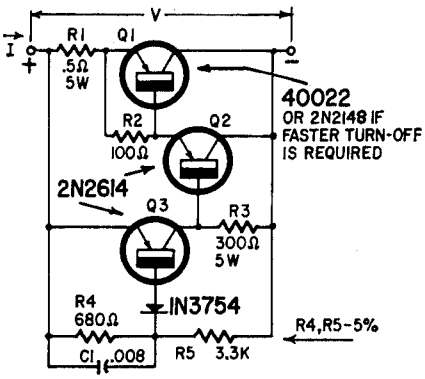

Figure 5: This RCA circuit can react to excessive current in a circuit and can break the circuit in less than 100 microseconds. It is effective but costly, remembering that a stereo system might require two or four such units.

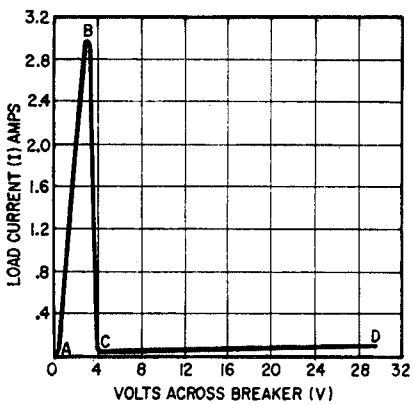

Figure 6: The voltage versus current characteristic of the RCA electronic circuit breaker shown above.

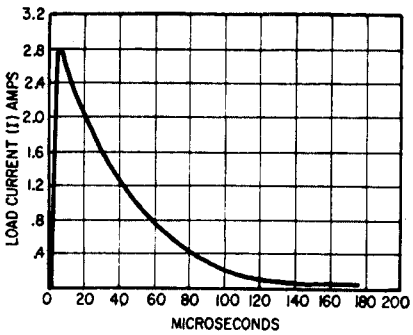

Figure 7: The limiting and turn-off characteristics of the RCA electronic circuit breaker, plotted against time in microseconds.

Such then was the thinking, three years ago, as set out in the "Radio-Electronics" article. It is reasonable to assume that many amplifiers sold in that period and in the hands of hi-fi enthusiasts will contain protection circuitry along these lines.

Fortunately — and gradually — output transistor overload and destruction is becoming less of a problem, and for a variety of reasons.

Perhaps the main one is that designers are now able to select transistors offering higher ratings for a smaller number of dollars. A few years ago, to obtain the required orders of power output at a competitive price, there was little option but to use germanium power transistors at close to their limit ratings and to rely heavily on carefulness and protection to minimise the number of breakdowns.

However, with improved manufacturing techniques and quantity production, output transistor ratings have gradually increased and prices have fallen making it possible for designers to produce the desired orders of power output with transistors offering a greater margin, particularly in respect to peak current rating — this without an undue cost penalty.

When this advantage is backed up by a careful choice of operating voltage, power supply regulation (or limiting) and overload behaviour within the amplifier itself, it is possible to produce an amplifier which is able to withstand accidental shorting of the output circuit under signal conditions without suffering automatic destruction of the output transistors. When this is achieved, fusing can be employed to take care of longer-term situations involving prolonged excessive current.

The Playmaster 115 amplifier, described in April, 1967, follows this general practice. Care should be exercised not to short the output circuit but, if it should happen accidentally, there is a good chance that the output stage will survive.

On the other hand, this is not true of the more recent "10-plus-10" stereo amplifier. Designed with an eye to cost, dictating germanium output transistors, a modest supply voltage and simple circuitry, there was no scope to build in any great tolerance to unfavourable load conditions. It is simply a matter of exercising care and NOT fiddling with the loudspeaker leads, with the amplifier in operation.

Perhaps we can sum up all that has been said in the following terms:

As a class, and for the reasons set out, transistor power amplifiers tend to react badly to a short-circuit across their output terminals (or to very low values of load) under signal conditions.

Some amplifiers have in-built protection circuits, while others rely on generously rated output transistors to increase their tolerance to adverse load conditions. Still others, particularly economy designs, do not include such provisions.

Overall, the position is still such as to justify the greatest amount of care in setting up or experimenting with transistor power amplifiers and certain basic rules are well worth observing:

1. Don't experiment with loudspeakers or their connections while the amplifier is switched on.

2. Don't switch the amplifier on, after you have made any changes, until you have double-checked for possible errors or shorts.

3. Don't try to operate the amplifier into loads significantly less than the minimum value specified by the manufacturer. You may get away with it but, again, you may not.

4. If your amplifier boasts in-built protection, be grateful but don't rely on it. Save it for "accidents." ■

Classical reviews

By JULIAN RUSSELL

Verdi's "Ernani" — unjustly neglected

VERDI — Ernani. Complete Opera. Carlo Bergonzi (Ernani); Leontyne Price (Donna Elvira); Mario Sereni (Don Carlo); Ezio Flagello (de Silva); Fernando Iacopucci (Don Riccardo). The RCA Italiana Opera Orchestra and Chorus conducted by Thomas Schippers. RCA Stereo LSC8006/1/2/3.

Anyone who attends vocal competitions must surely have heard "Ernani, involami," a famous soprano aria; but that will probably be all that they know of Verdi's opera, for it is seldom heard nowadays—that is, outside Italy. It was first performed in Venice in 1844, in London in 1845, and in New York in 1847. It then had to wait until 1903 for revival at New York's Metropolitan. It was recorded complete in 1960, but RCA's is the first to follow that event, so far as I can trace. Certainly the first in stereo. To me this is unjust neglect because the work is full of good melodies, some of them as beautiful as any Verdi ever wrote.

That it has a libretto which nowadays appears to be ridiculously romantic does not set it apart from many other Verdi operas which suffer from the same failing. It was, by the way, adapted from a puzzlingly successful play by that arch romantic Victor Hugo. Its love interest, though extravagantly passionate enough to provide first-rate Verdian operatic material, must seem very novelletish to this century's audiences. And it is the only opera I know in which the hero undertakes to kill himself when he hears a blast on a horn.

It is presented complete, without cuts, in the RCA performance, a performance notable for beautiful playing from the orchestra and some impressive singing by the principals and chorus. Well worthy of notice is the conductor's insistence on true pianissimos, a feat not always easy to bring off in directing Italian companies. From the very first bars, Schippers wins crisp articulation in the dotted rhythms and true Verdian surges of emotion as he goes along. Some might think the chorus a little backward in relation to the orchestra, but to me this offers no hardship when the orchestral playing is as good as you hear here. Even Verdi's tum-tum accompaniments have a vitality that reminded me inevitably of Toscanini's treatment of similar phrases in "Il Trovatore."

Carlo Bergonzi is my favourite Italian singer of the present generation, and I was not disappointed with his performance in the title role. His voice is as sweet-toned as ever, his interpretation essentially refined — in the best meaning of the word. Leontyne Price, too, is in famous form though she doesn't, here, at any rate, match the variety of Bergonzi's colour changes. Mario Sereni and Ezio Flagello are admirable in their roles and the production is in the safe hands of Richard Mohr, who might, without condescension, be described as America's John Culshaw. If you're looking for an unhackneyed Verdi opera, prodigal in lovely tunes and excellently recorded, you should enjoy this RCA issue.

★ ★ ★

JULIAN BREAM—20th Century Guitar. Pieces by Brindle, Britten, Martin, Henze, and Villa-Lobos. RCA Stereo LSC2964.

Julian Bream has an unassailable reputation both as a guitarist and lutenist, and his admirers know they are in for a treat whatever he records. But what makes this new record of his different from any other guitar recital available — at any rate, that I have heard—is his choice of program. For here he has selected works, for the most part by living composers, who have extended the instrument's range considerably.

As a rule, guitar recitals are somewhat disappointing to all but guitar buffs, chiefly because of the paucity of good material written specially for the instrument. Players usually fill out their programs with transcriptions of music written for other instruments—Bach seems to be the favourite—that, in my opinion, would have sounded better in their original form. Even a Segovia recital as a rule suffers from the introduction of such items which are generally included towards the end of a recital when one has already received the satisfaction of having heard peerless performances of work culled from the instrument's literature.

This time, however, Bream has collected a program of works of impressive originality that exploit hitherto unheard-of effects by contemporary, though not necessarily 12-tone composers. Among these I found Britten's "Nocturnal" easily the most interesting and most enjoyable. It is in the form of what might be loosely described as a set of variations on a theme of Dowland and during its roughly 19 minutes' duration, the composer describes the changing moods of one seeking sleep. Some are agitated, other reflective, some are even march-like, but all lead towards a gentle sinking into quiet slumber. To Bream, according to the sleeve notes, it is the finest work ever written for the guitar, and, with my limited knowledge of the full range of the instrument's repertoire I am inclined to agree. It exploits hitherto unheard sonorities, and covers a range of moods unmatched in anything I have ever heard composed for the instrument.

The truly avant garde item is Brindle's "El Polifemo de Oro" based on a tone-row heard at the beginning. The fact that this work can be repeated at will in one's home will enable the curious to trace the treatment of this row from bar to bar. But, despite the composer's strict 12-tone discipline, his music never loses its strong Spanish flavour while resolutely avoiding the usual Iberian cliches.

Generally speaking, I am not very keen about the music of the Swiss composer, Frank Martin. It is, to me, usually very dry and cerebral. An opera of his I heard in Munich in 1962, "Le Vin Herbe," based on the Tristan theme, seemed to me a very anti-Tristan—in the Wagnerian sense—exercise so boring that I found it difficult to stay awake, though it is not long. But he has written at least one very moving piece, "Plainte," in this recital, and the other three items in the suite are much less desiccated than the general run of the composer's work.

Hans Werner Henze, represented here by his "Drei Tentos," could be called an eclectic composer whose music should offer only small difficulty to those comfortable in the modern idiom. Here, although the composer is German, the influence is Italian, but again no cliches are used to evoke the local atmosphere. Villa-Lobos' two studies are the most conventional pieces in the recital and use tuneful melodies as a basis to exploit the virtuoso possibilities of the guitar.

I had better warn those who think of the guitar solely as an instrument on which to strum rhythmically either Spanish dance forms or accompaniments to what nowadays pass for folk songs—how the term has become debased during recent years!—that this disc will not appeal to them at all, despite the indubitable brilliance of Bream's playing. Indeed, there is not one really "pretty" bar in the whole recital. But there is not one uninteresting one either to those who are looking for a new experience, indeed one could truthfully say a new sound, in this delightful disc.

★ ★ ★

SCHONBERG Complete Piano Music. Drei Klavierstucke, Op. 11. Funf Klavierstucke, Op. 23. Sechs Kleine Klavierstucke, Op. 19; Suite fur Klavier, Op. 35; Klavierstucke, Op. 33a and 33b. Glenn Gould. CBS Stereo SBR-235270.

To all students of avant garde music this disc of compositions by the movement's father will be a must. As a pianist, Glenn Gould is much more proficient than was the composer, from what is known of his playing. But this did not prevent him from adding something new to the instrument's literature. The recital goes all the way from the early Op. 11, three pieces which were, according to Gould's perceptive sleeve notes, "the first major test of the possibilities of survival in a musical universe no longer dominated by a triadically centred harmonic orbit." From these, to Schonberg's first work to be written strictly in 12-tone style, the Op. 25 Suite.

I like best, even at this late stage of my musical development, the Op. 19 in which you will hear six tiny pieces of Webernlike brevity and delicacy. But that is not to say that I did not find the whole recital of absorbing interest, even if some of it I didn't enjoy very much. Gould plays all the pieces with passionate advocacy and displays a deeply perceptive appreciation of the composer's aims and achievements in his copious and informative annotations. If you follow him with a score, you will find the usual tendencies to extravagancies, side by side with faultlessly logical interpretations. And he is mercifully silent vocally during this long recital. Indeed, during his recent recordings he seems definitely to have abandoned the irritating practice of humming and making other extraneous noises during the recording session. The engineering is first rate.

★ ★ ★

DVORAK — Symphony No. 9 in E Minor (From the New World). New Philharmonia Orchestra conducted by Antal Dorati. Decca. Phase 4 Stereo SKLA 4880.
The London Symphony Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6291.

Dorati's version of this popular symphony is good. And moreover it has the benefit of the Phase 4 recording process which emphasises stereo spread —but not unnaturally—and focuses more than customary attention on orchestral soloists. Kertesz is recorded by Decca's orthodox but still fine process and is superb. Indeed I now find it, without any qualifications at all, the best of all available both in the past and present. It might seem odd to many readers that, despite the innumerable accounts of the "New World" issued since the introduction of LP and later, stereo, I have for many years thought Szell's old 78s of the work the best, though admittedly its sound today leaves much to be desired. It was issued, by the way, on an old Plum Label, a cheap one of the period.

As a result of having what many might regard as a prejudice firmly established in my mind I have always used the Szell version as a yardstick to measure subsequent recordings. In future I shall always use the Kertesz. His tempos closely resemble Szell's in so far as they are never mannered, and the many difficult transitions from subject to subject in the first movement are brought off without any jarring changes of gear. The little "knight's move" theme in the first movement—I suppose it can be called the third subject—is never clumsily retarded, though a fractionally slower tempo establishes its character unassailably.

Then again, the slow movement which lends itself so easily to trivialisation when played sentimentally is delivered here with all the nobility of which the music is capable. The cor anglais solo is rapt and never quavers, the brass superb in their dignity. The Scherzo is deliciously crisp and its steady tempo—which, however, never sounds as if it is dragging—gives the movement added point. The Finale adds up to a climax, with every note of the counterpoint clearly discernible, of overwhelming intensity. It is the crowning achievement of Kertesz' and

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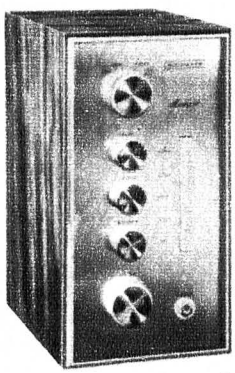

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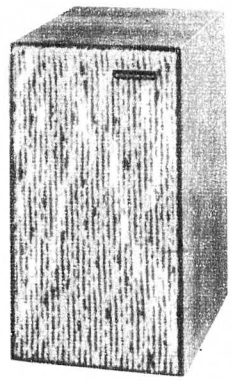

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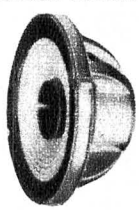

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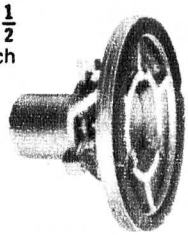

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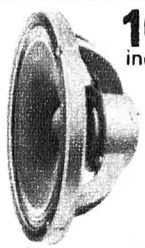

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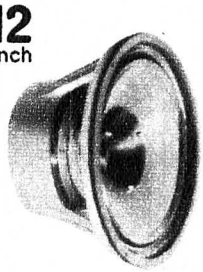

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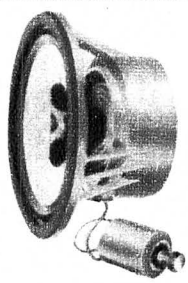

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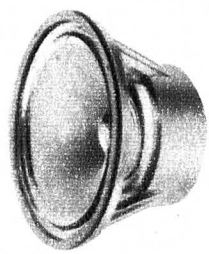

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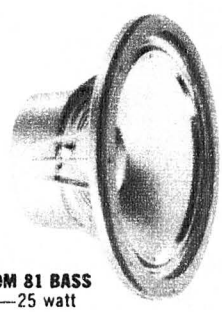

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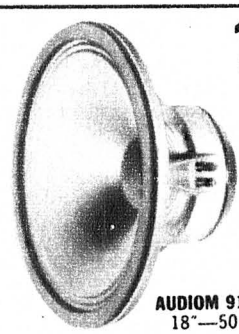

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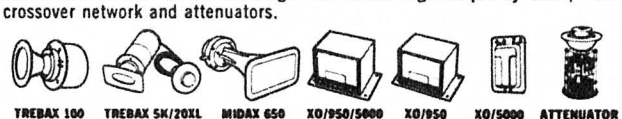

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the LSO's integral recording of Dvorak symphonies.

There seems to be little point in making a close comparison of the Kertesz and Dorati versions. Strangely, in England, Decca issued the Dorati only a month after the Kertesz. It is undeniably good and the Phase 4 recording might appeal more than the orthodox process to those who wish to demonstrate the fidelity of their sets to admiring friends. All the first desk soloists receive their full share, and sometimes a little more, of the spotlight. But whereas you will find only the symphony on the Dorati issue, the Kertesz, in addition to its other virtues, finds room for Dvorak's "Othello" Overture, admittedly no great shakes as a composition, but still well worth owning as a curiosity not easily found elsewhere. I am afraid I didn't have to do very much listening to plump heartily for Kertesz.

★ ★ ★

ROMOLA COSTANTINO — French Piano Music. Pieces by Ravel, Debussy, Faure. E.M.I. Stereo OASD 7545.

Just why Miss Costantino chose the black and white version, admittedly the composer's own, of such a gorgeously scored work as "La Valse," I shall never know, unless she tells me. Miss Costantino is a Sydney-born pianist of Italian origin and is also one of the "Sydney Morning Herald's" team of music critics. Her recital of French piano music is always immaculately, if a little coolly played. For that reason I liked her best in the two Pavanes, Ravel's and Faure's, and in some of the items of Debussy's "Suite Bergamasque."

Her playing of Ravel's La Valse is, for the most part, impressive technically, so good indeed that it makes one regret that she must have spent valuable time on its preparation, time that might have been devoted to a more grateful piece. And while Laurence Godfrey Smith's transcription of Faure's pleasant little song, "Nell," is competent, I can't see that this, either, adds much glamour to Miss Costantino's recital. My guess is that the two pieces were included because of their unhackneyed character.

★ ★ ★

SAMSON FRANCOIS — I Like Debussy. Clair de Lune; Maid with the Flaxen Hair; Sunken Cathedral: La Plus que Lente; L'Isle Joyeuse; Minstrels; Pour le Piano; Danse de Puck and others. Capitol Stereo SP8658.

Some of the annotations are as arch as the title of this somewhat uneven disc. For example: "With flaxen hair and cherry lips, she sits on the flowering grass singing a morning song. The composer is enchanted, and aren't you glad." To which my answer is, "No!" And again, and to me, still more offensively: this time about "The Sunken Cathedral": "You see, it's like this—the ocean (how did you guess?) is the home of the cathedral of Ys which, upon occasion, rises out of the ocean with bells tolling and priests chanting. All this Claude (note the hideous familiarity. J.R.) set to music full of wave after wave of Gregorian melody, medieval harmonies and other motifs."

You begin to get the idea? Yet the annotations do not reflect the quality of Francois' playing which, apart from some expected mannerism by those who have heard him play before, is of a generally high standard. True, he sentimentalises "Clair de Lune," "La Plus que Lente," and "The Girl With the Flaxen Hair." But, as I noted above, this might have been expected. But his technical accomplishments in "Minstrels" are impressive and, though his choice of items tends towards the more popular, "The Sunken Cathedral" is added to give the program a little more welcome weight. The recital might perhaps be summed up as Debussy's prettiest pieces for the most part prettily played. But, oh, those sleeve notes.

★ ★ ★

DEBUSSY—Iberia.
ALBENIZ—Iberia.
French National Radio Orchestra conducted by Charles Munch. Concert Hall Stereo SMS2494.

These two suites share only a name in common. The Debussy is thought by many to be Debussy's finest work for orchestra. The Albeniz is colourful, and was orchestrated by Arbos from a group of piano pieces by the composer. A factor that might appeal to buyers is the price of the issue, which is put out at a club markup. In the Debussy the French National Radio Orchestra play much more sensitively for Munch than they did at the concert I heard them give under that conductor in Paris in 1962. And it is perhaps only the brilliant clarity of the engineering that makes the first movement sound ever so slightly slack rhythmically.

But what you lose on the swings here you gain on the roundabouts in the slow movement where this splendid definition makes the beautiful writing for divisi strings a delight. By the way, I found the whole of this side was improved by making a slight cut in the highs on my equipment. This done, the scented, evocative atmosphere of the second movement, entitled "Perfumes of the Night" becomes dreamlike and poetic. And I liked particularly the thin, extra-reedy French tone of the oboist, who has a very important role in the movement.

There is no hint at all of rhythmic slackness in the Finale, which is presented with the animation one finds in a town about to celebrate a holiday. The bustle is unforced, but a sense of expectancy pervades every bar of the lovely score.

With a performance of the Albeniz that sounds genuinely Spanish in both feeling and rhythm, and is played with admirable technical and idiomatic skill, this makes a very attractive buy at an economy price.

★ ★ ★

CHOPIN—The Four Scherzi. Prelude Op. 45. Barcarolle, Op. 60. Vladimir Ashkenazy. Decca Stereo SXL6334.

Vladimir Ashkenazy, who is making a welcome tour of Australia next year, offers dazzling performances of these difficult pieces. Without timing them, I would guess that he plays them faster than anyone else I have ever heard. But this might well be due to an illusion caused by the perfect articulation he uses which, no matter how fast he plays, makes every note stand out individually without pressing on the heels of its predecessor. And Ashkenazy's is no mere use of the Scherzi as vehicles to display empty virtuosity. His readings are unquestionably valid at the tempos he has chosen.

In only one of them might some hypercritical listeners feel that his reading is slightly on the heavy side. Personally, I have no quarrel with it as played here, for it is essential to take into consideration the natural tone of the modern pianoforte which varies considerably from those used in Chopin's day. If you're looking for a slightly more Romantic performance of the works, but one which still dazzles with its technical excellence, you may perhaps prefer Rubinstein's record of them for RCA. Rubinstein is perhaps a trifle more Chopinesque, Ashkenazy rather more Lisztian in his interpretations. But then Rubinstein is content to avoid the stunning effect of Ashkenazy's blazing brilliance.

That Ashkenazy is not lacking in romantic warmth—and no one who has heard his previous recordings of Chopin will suspect that he is — is proved by his delicious playing of the two extra pieces, the Barcarolle, and the Prelude, Op. 45. The whole disc, which is excellently engineered, will, in my opinion, long remain an outstanding example of modern Chopin playing.

★ ★ ★

VERDI — Falstaff. Complete opera. Tito Gobbi (Falstaff); Luigi Alva (Fenton); Rolando Paneral (Ford); Tomaso Spataro (Dr Caius); Renato Ercolani (Bardolph); Nicolo Zaccaria (Pistol); Elisabeth Schwarzkopf (Mistress Ford); Anna Moffo (Nanetta); Nan Merriman (Mistress Page); Fedora Berbieri (Mistress Quickly). Philharmonia Orchestra and Chorus conducted by Herbert von Karajan. World Record Club Stereo. S4380/1/2.

There have been two other complete "Falstaffs" issued since the Karajan/Columbia set first made its appearance in 1957—one for C.B.S. with Bernstein conducting and Fischer-Dieskau in the title role, the other for RCA with Geraint Evans as the jolly knight and Solti as conductor at about the same time, though the latter has never been generally available in Australia. I have, however, always preferred the Karajan set, even when it was, for quite a while, obtainable only in mono in Australia. And now that the World Record Club has reissued it in stereo, I find it all the more attractive.

Gobbi is perhaps ever so slightly refined as the fat hero—Evans made him a much more earthy fellow—but he is unfailingly musical and a delight to listen to in every bar. Then there is the, to me, inimitable Schwarzkopf as Mistress Ford, her soft top notes unmatched by any other soprano at the time or since. And Anna Moffo's deliciously girlish Nanetta should not be forgotten. There is also Karajan's ebullient handling of the ensemble, letting the rich humour of the music speak for itself instead of constantly digging one in the ribs to make a point as Bernstein is inclined to do. All things considered, I think the W.R.C. reissue of this great opera an outstanding bargain at its club price. ■

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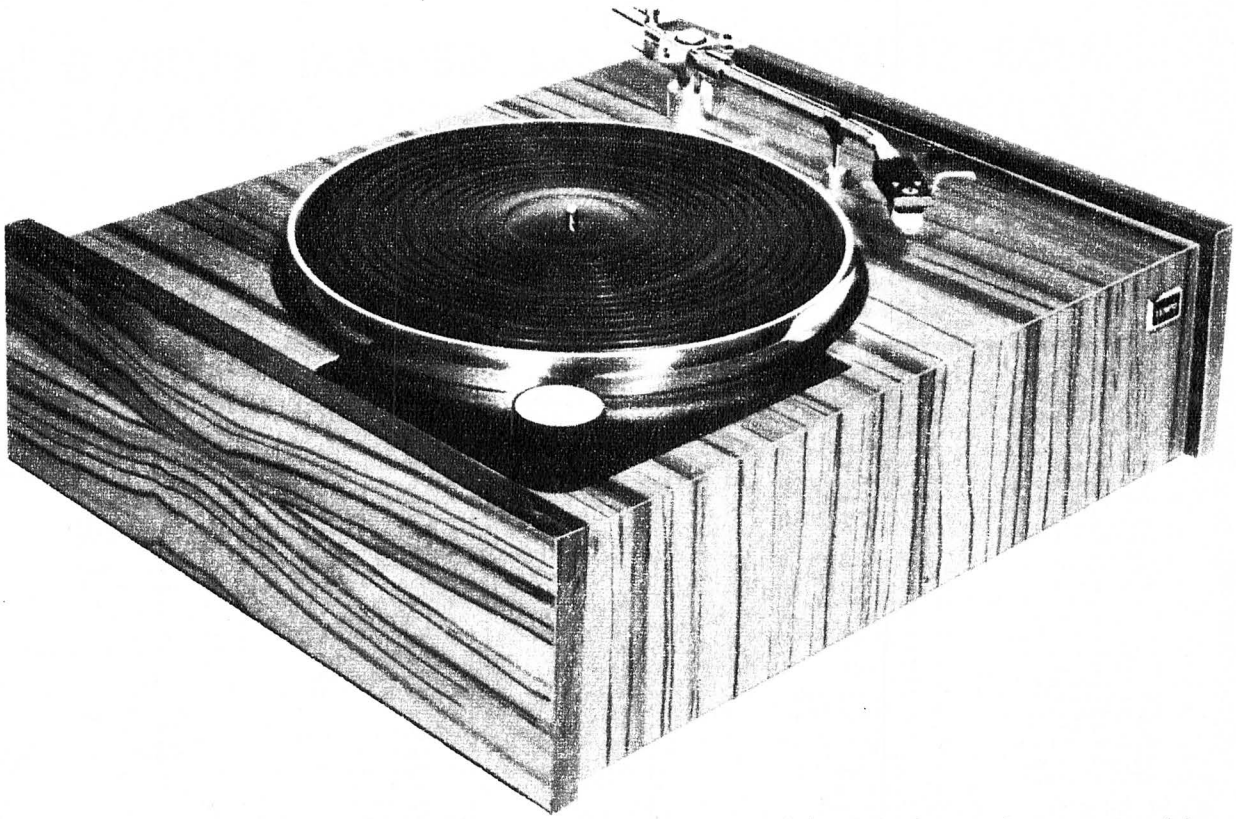

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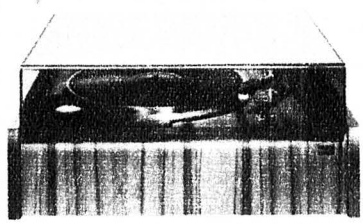

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DOCUMENTARY RECORDS

Reviewed by Glen Menzies

A CHRISTMAS CAROL, based on the classic story by Charles Dickens. Bernard Miles and Company with the Bach Choir and the Jaques Orchestra conducted by David Willcocks. World Record Club. SMW 2007. (Stereo).

This production is a delight from start to finish. Apart from his excellent work as the narrator, Bernard Miles makes a memorable role of the part of Scrooge. A small band of actors, some of whom play several parts, give strong support.

I have seldom heard music used to such effect as it is here; the Bach Choir and the Jaques Orchestra combine in helping to make this an unusually beautiful and atmospheric presentation of the Dickens classic. No less than 10 well-loved Christmas Carols are heard throughout and Vaughan-Williams' "Fantasia on a Theme of Thomas Tallis" is used to equally great effect.

The well-known ghost scenes are treated skillfully. The ghosts are suitably larger than life without descending into the "hamminess" which is always a danger in this kind of thing.

The production itself must have been planned with some of the same care that goes into the recording of an opera in stereo—there is real fluidity of movement. The sound effects operator is given plenty to do, but the sound effects themselves are never overdone, instead they help to create and sustain the atmosphere of the story.

Altogether then, this is a splendid production of one of the best loved tales in the English language. Although the cover note does not say so, I presume that Bernard Miles had a lot to do with the production; and, of course, the musical direction by David Willcocks is impeccable. A Christmas record to treasure for many years to come.

★ ★ ★

THE PRODUCERS. Music and Dialogue from Mel Brooks' motion picture, featuring "Springtime for Hitler." The original soundtrack recording, with music composed and conducted by John Morris. RCA Stereo LSP4008.

Here is a really off-beat soundtrack album which is just as amusing as it is unusual and although it comes from a crazy film, it actually makes for very coherent and always entertaining listening.

The whole Broadway show-biz thing is turned upside down in this story of an avaricious Broadway producer called Max Bialystock whose accountant, Leo Bloom, works out a cunning scheme to make big money from the production of a flop musical. In devising it, they manage to send up plenty of hoary old traditions connected with Broadway show-biz.

It begins with Bialystock and Bloom talking over the scheme and deciding to look for the world's worst play to be produced by the world's worst director. Hilarious auditions take place and a musical called "Springtime for Hitler" is their choice and from a line of excruciatingly bad singers they choose a pop singer for the part of Hitler. Lots of little old ladies are persuaded to take out big parcels of shares in the venture, but instead of being a flop it becomes a hit overnight. The love story of Hitler and Eva Braun is a riot and, incidentally, there is some good satire here on the Hitler-type mentality.

I would imagine just judging from this album that the film is one of the most amusing since the heyday of the Marx brothers. The larger than life characters of Bialystock and Bloom are played brilliantly by Zero Mostel and Gene Wilder with the rest of the cast not far behind.

The editing has been handled very well, and the dialogue remaining gives a good sense of continuity. No less witty and amusing is the film's musical score by John Morris with a couple of catchy tunes tossed in for good measure. Jazz fans will enjoy the piano sequence which provides background music for a cocktail lounge discussion between Bialystock and Bloom.

Recording quality is also a cut above some of the other sound track recordings I have heard. The stereophonic sound spreads right across the room. The only criticism is that sometimes, in order to hear all the asides of the dialogue, the replay level makes for rather loud music in some spots.

★ ★ ★

POEMS BY JUDITH WRIGHT read by John Clements with an introduction spoken by the author. Music for Pleasure. Mono 8047.

I was pleased to see that Music for Pleasure had included this album in their first batch of releases, as it now becomes available to a wider public and at a very reasonable price. It also contains a good cross section of the work of one of our finest poets, spanning the years from 1946 to 1963.

Judith Wright herself advised John Clements in the choice of the poems, taken from five different volumes: "The Moving Image — The Gateway — Woman to Man — The Two Fires —Five Senses." More than enough to indicate that Miss Wright has a rare lyrical gift matched by a genuine depth of thought and feeling. Some of her work is quite challenging in its use of imagery and symbolism.

In an excellent cover-note, T. Inglis Moore says, in regard to the poem "Woman to Man": "After the poems in 'The Moving Image,' in the 'Woman to Man' volume, the poet turns from time to the theme of love, from the outward world to the inward one, from objective description to emotion and meditation. In the title piece, passion and intellect, imagery and music, are all harmonised in a lyric of power and beauty. This is also a poem with a difference, since its focus is not on the lovers or love, but its consummation in the child."

I think that the words just quoted help to indicate the special quality of Judith Wright's poetry and the problems posed for the narrator, who must do more than merely recite the poems. This is something that Mr Clements does not entirely avoid doing with his essentially elocutionary style of delivery. There are times when he seems to be addressing himself to an audience beyond the confines of my room. That the problems can be overcome we have learned from the series of poetry readings on the English Argo label.

On the credit side, I enjoyed Mr Clements' reading of poems like "Train Journey," "The Surfer," "Bachelor Uncle" and "The Metho Drinker." The latter is a short but sharply observant poem which captures exactly the tragedy and loneliness of the drinker.

From an historical point of view, this album has some importance, because of the brief introductory remarks by Judith Wright herself at the start of side 1. ■

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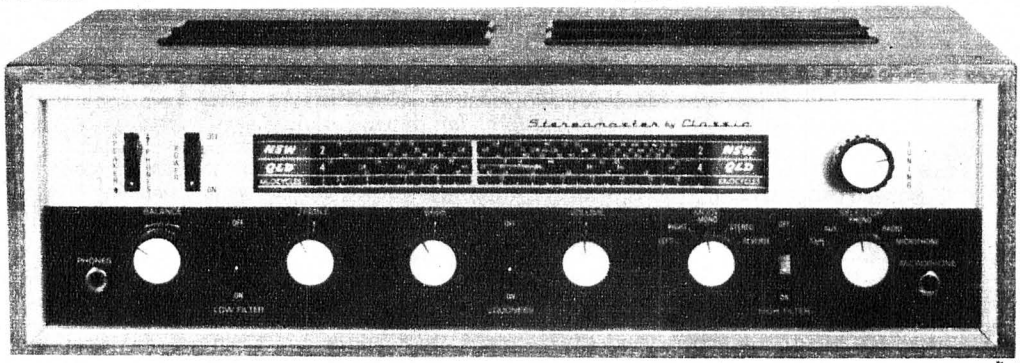

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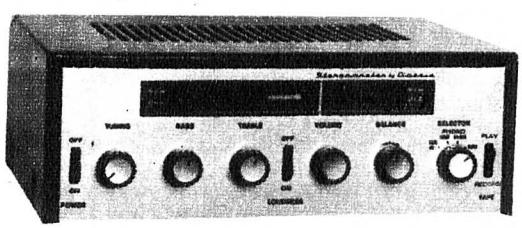

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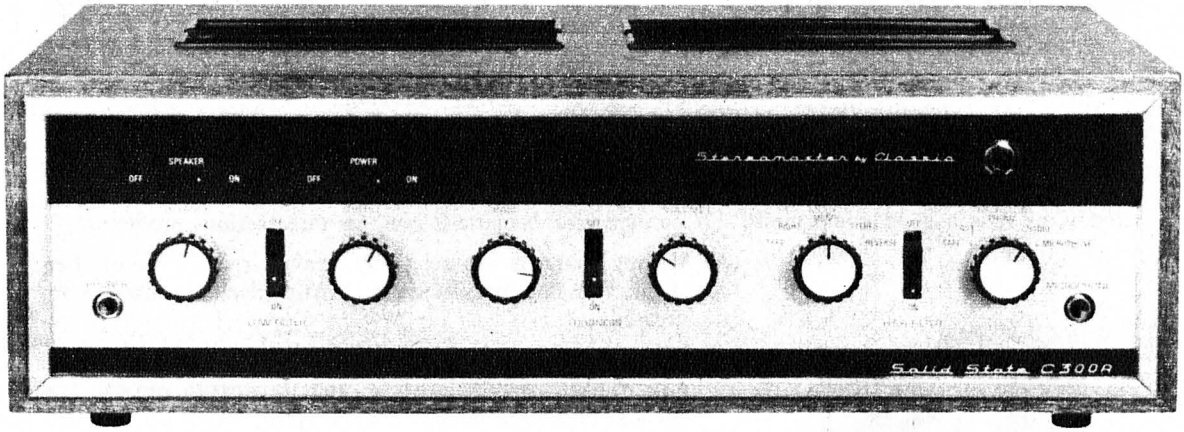

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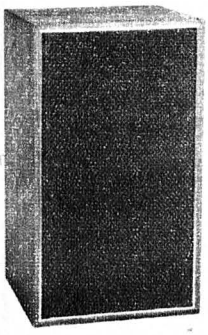

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SOUND THOUGHTS

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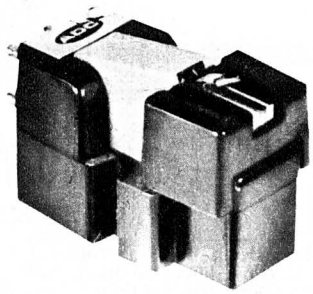

The new ADC 550E cartridge

(A) Moving magnets are relatively heavy, irrespective of their shape, thus the mass at the stylus tip (dynamic mass) is increased.

(B) This increased moving mass will resonate with the vinyl disc within the audible range, and, to smooth out the frequency response, damping is required, which is undesirable.

(C) To obtain reasonable efficiency, both poles of the moving magnet must be placed between the four pole faces in the cartridge body, thus necessitating a fairly long cantilever (stylus arm), in order to give sufficient stylus clearance and to maintain the correct vertical tracking angle. This long cantilever is very difficult to make with adequate stiffness, to prevent resonance or decoupling without excessive mass.

ADC realised that the moving magnet design concept was limited and invented and introduced their patented INDUCED MAGNET PRINCIPLE in 1963, which features all the advantages of the moving magnetic cartridge, but dramatically reduces the weight of the moving mass. ALMOST LIKE HAVING YOUR CAKE AND EATING IT, AS A NOTED REVIEWER PUTS IT (Audio, U.S.A.)

Above problems could thus be overcome. The conventional moving magnet was replaced by a tiny soft iron collar weighing far less and the "heavy magnet" itself placed outside the system.

It is most obvious that such a changeover was associated with a lot of "brain drain" and expense and that it would not have been made unless fully justified.

The experts' opinion and the popularity of ADC cartridges leaves little doubt and here are just a few quotes from leading high-fidelity publications, which refer to the new design concept:—

AUDIO, U.S.A.: "A distinct improvement over preceding cartridges made by this company, which were also quite excellent. The method, whereby the stylus mass is reduced, is quite ingenious."

THE AMERICAN RECORD GUIDE, U.S.A.: "A strong jump up from that company's previous moving magnets, which were themselves sonic advancements."

THE GRAMOPHONE, U.K.: "The effective mass as seen by the stylus is about as small as it could possibly be."

HI-FI NEWS, U.K.: "The use of a fixed magnet, separate from the moving system, liberated the stylus bar, which no longer has to carry the moving magnet."

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VARIETY FARE

Reviews by: Neville Williams Harry Tyrer
T. Forbes Cameron

Devotional and Christmas

CHRISTMAS MUSIC FROM WESTMINSTER ABBEY. Westminster Abbey Choir conducted by Douglas Guest (Master of the Choir and Organist). Simon Preston, Organ. Stereo, EMI OCSD-3636.
Interest: Christmas of another era.
Performance: Quiet, unhurried.
Quality: Marred by extraneous noise.
Stereo: Modest.

The contents of this album have little in common with the familiar Christmas carols and even less with tinsel and sleigh bells. Led mainly by the boys' choir, with occasional support from the adult choir and organ, these are songs of adoration for the Virgin Mother and the Christ Child:

A Spotless Rose (Herbert Powell) —Sing Lullaby (Howells) — Here Is The Little Door (Howells - Chesterton) —Psalm Prelude, organ solo (Howells) — I Saw A Fair Maiden (Warlock) — Wither's Rocking Hymn (Vaughn Williams) — Christmas Now Is Drawing Near At Hand (Vaughn Williams) — Whence Is That Godly Fragrance (arr. C. H. Kitson) —A Hymn To The Virgin (Britten)—There Is No Rose Of Such Virtue (Jouberr) —Carillon, organ solo, Murrill.

Already of rather restricted interest, the appeal of the album is likely to be limited further by its technical shortcomings. Recorded, presumably, in Westminster Abbey, the entire performance is heard against a constant rumble of extraneous noise. Presumably, the recording engineers elected to put up with this, in order to preserve the atmosphere of the vast building and to retain the full dynamic range for the gigantic voice of the organ in Howell's Psalm Prelude.

Even with memories of the Abbey still fresh in my mind, this is the kind of realism that I would nevertheless be prepared to forgo. (W.N.W.)

★ ★ ★

IN DULCI JUBILO. Clare College Singers and Orchestra, conducted by John Rutter. Organ, Jeremy Blandford. His Master's Voice (E.M.I.) Stereo OCSD 3634.
Interest; Carols from Cambridge.
Performance: Good amateur standard.
Quality: Average.
Stereo: Good.

As a collection of British and European carols, this performance is pleasant enough, but it is difficult to be more than non-committal about it, since there are no special distinguishing features about which one can be enthusiastic. That is, unless one takes into account the two carols written especially for this program by the conductor, John Rutter, which add an interesting touch. The performers are all amateur, and as such may be considered of high standard, but their performance suffers from the faults of most amateur performances — lack of precision and poor enunciation. As I said before, pleasant enough, but not a disc one can get enthusiastic about.

Shepherd's Pipe Carol (Rutter) — Infant Holy, Infant Lowly — Angel Tidings — Quelle est cette Odeur Agreeable — Once in Royal David's City — Il est Ne L'Enfant Divin — Of the Father's Love Begotten — I Saw Three Ships — Down in Yon Forest — In Dulco Jubilo — Nativity Carol (Rutter) — Quem Pastores Laudavere — Rocking — The Twelve Days of Christmas. (H.A.T.)

★ ★ ★

CHRISTMAS WITH ED AMES. With choir and orchestra, arranged and conducted by Frank Hunter and Marty Gold. Stereo, RCA Dynagroove LSP-3838. Also in mono LPM-3838.
Interest: Pleasant Christmas music.
Performance: Pleasing.
Quality: Very good.
Stereo: Used effectively.

Ed Ames has a rich, well-modulated baritone voice well suited to this kind of album. With equal facility he copes with a couple of the more jolly Christmas songs, a number of the standard carols, a spot of recitation, a Negro-style carol and a protest number: Deck The Halls — Let It Snow — Oh Come All Ye Faithful — Away In A Manger—Do You Hear What I Hear? —Joy To The World—The Ballad Of The Christmas Donkey — Sweet Little Jesus Boy — I Wonder As I Wander — I Heard The Bells On Christmas Day — The First Noel.

Backed by chorus and orchestra and cleanly recorded in the Webster Hall, New York City, this is pleasant listening indeed and should prove one of the most popular of this vear's family Christmas albums. (W.N.W.)

★ ★ ★

PIPES AND CHIMES FOR CHRISTMAS. Buddy Cole at the pipe organ. Stereo, Harmonv HAS-142. Also in mono HA-142.
Interest: Mainly pipes.
Performance: Relaxed, capable.
Quality: Good.
Stereo: Modest.

What does a well-known entertainment organist do when requested to produce a Christmas album? Be conventional. conservative or pull every trick in the Wurlitzer book?

Buddy Cole has come up with a program which is nicely balanced between the sanctity and gaiety of Christmas. The organ is not named but the voicings used range from a bright church sound to theatre-plus-tremulant, and from gentle solos to sound that is quite massive.

The titles: It Came Upon A Midnight Clear—Deck The Hall — What Child Is This? — The First Noel — Jingle Bells — O Tannenbaum—Good King Wenceslas — The Coventry Carol — Joy To The World—O Little Town Of Bethlehem—Adeste Fideles—Away In A Manger—We Three Kings —God Rest Ye, Merry Gentlemen — Silent Night.

For what it is intended to be, a pleasant, well-played album. (W.N.W.)

★ ★ ★

A MERRY CHRISTMAS AND A HAPPY NEW YEAR. The Korean Orphan Choir conducted by Chai Hoon Park. M.S.M. Mono. Word (Gospel Film Ministry). WST-8361-LP.
Interest: As per title.
Performance: Refreshing.
Quality: Some surface prickles.

Over the years we have reviewed several albums of performances by the Korean Orphan Choir and the impact is always the same, excellent presentation, with freshness and appeal. Sponsored by World Vision Inc. the choir was on its third U.S. tour when this recording was made. Of the 37 children in the choir, all between the ages of eight and 16, 13 have been involved in previous tours.

The choir is conducted on this occasion by Chai Hoon Park, conductor at Young Mak Presbyterian Church in Seoul, Korea, one of the largest Presbyterian congregations in the world.

In their Christmas program, they present: We Wish You A Merry Christmas — Caroling, Caroling—The Morning Star—O Leave Your Sheep —At The Sweet Birth Of Our Lord —Birthday Of The King—Silent Night — Deck the Hall — O Holy Child We Welcome Thee — Angels O'er The Fields Were Flying—Sleep Of The Child Jesus—Lo, How A Rose — We Wish You A Merry Christmas.

I understand that G.F.M. were not too happy with the local stereo pressing of this album but the mono will pass muster with the treble control down just enough to take the edge off any surface crackles. The sound otherwise is well balanced. (W.N.W.)

★ ★ ★

CHRISTMAS SONGS. The Vienna Boys' Choir conducted by Professor Hans Gillesberger. Decca (E.M.I.) Stereo SKLA 4891.
Interest: German carols.
Performance: Splendid.
Quality: Good.
Stereo: Well spread.

Since most of the carols here will be unfamiliar to the majority of Aus-

tralians and they are sung in German, I fear this disc will have only limited appeal. This is a pity, for the singing of the choir is of a quality which is unique. I know the expression "singing like angels" sounds trite, but I can really find no more suitable expression in this case. There is possibly no other group of young singers in the world which can equal the purity of tone, precision of attack and fine control of dynamics of this group, but over and above these qualities there are more ephemeral qualities — a sincerity and natural happiness — which makes them a delight to listen to. If you appreciate fine singing, I suggest you should try to get your dealer to play you a sample track or two—try the first track of side two, that old chestnut "Silent Night," and see what a group of this quality can do with it.

Track titles (English translations) are: A Beauteous Rose — In Dulci Jubilo — Joseph, Dearest Joseph Mine — Susani — Run You Shepherds, All Together — Silent Night — Johnny — The Heavenly Gate Has Opened Wide — Hush, Hush, Hush — Come Hither Shepherds, All Together — It Soon Will Be Dark — Come, All You Children — O Thou Gladsome. Full translations of the words are given on the sleeve. (H.A.T.)

★ ★ ★

A FESTIVAL OF CAROLS IN BRASS. The Philadelphia Brass Ensemble. C.B.S. (Australian Record Company) Stereo SBR235286.

Interest: See title.
Performance: Tasteful simplicity.
Quality: Very good.
Stereo: Normal.

The instruments used here are two trumpets, French horn, trombone, euphonium and tuba and, since the performers are all first desk players from the great Philadelphia Orchestra, one might have expected some display of virtuosity. In fact, the arrangements used are so simple and straightforward that they sound as though they came straight out of the Salvation Army hymnbook. Not that this is a bad thing — on the contrary, displays of virtuosity in a collection of Christmas carols might have seemed out of place, or even in bad taste. The tone of the instruments is, of course, superb. The 25 carols in the selection include all the usual ones with a few lesser known titles, such as Lo, How a Rose E'er Blooming — Bring a Torch, Jeanette, Isabella — O, Sanctissima — The Twelve Days of Christmas. In the last-named piece, the band has their only opportunity to show their paces, with a lively arrangement by Andrew Kazdin. (H.A.T.)

★ ★ ★

MORE FAMILY CAROLS. The Bach Choir with John Carol Case, baritone, and the Jacques Orchestra conducted by David Willcocks. Columbia (E.H.I.) Stereo SCXO 6179.

Interest: Familiar and unfamiliar carols.
Performance: Very high standard.
Quality: Very good.
Stereo: Well spread.

The carols here have been chosen from those presented by the Bach Choir in a series of Family Concerts in London concert halls in recent years. The titles range from the very familiar (Hark the Herald Angels, I Saw Three Ships, While Shepherds Watched) to relatively unknown (In the Bleak Mid-Winter, We've Been Awhile A-Wandering, I Sing of a Maiden). The very generous program has 17 tracks in all. The singing is of a very high order, of fully professional standard. The technique adopted is to sing one verse in simple arrangement, then to continue with intricate descant passages and elaborate harmonies. An excellent disc which will appeal to connoisseurs of fine choral singing. Other track titles include: Psst Three o'clock —Up, Good Christian Folk—It Came Upon the Midnight Clear — Masters in this Hall—The Three Kings — Rocking (H.A.T.)

★ ★ ★

RUDOLPH THE RED-NOSED REINDEER. Gene Autry. Harmony (Australian Record Company) Stereo HAS 140. Available in Mono.

Interest: C. and W. Christmas.
Performance: For the young folk.
Quality: Good.
Stereo: Normal.

Obviously intended for the younger members of the family, this one. None of the songs have a religious motive, but are all of the "Santa" variety. Veteran Hollywood cowboy Gene Autry sings them in country and western style, with backing by a typical C. and W. group. The tune titles are: Santa Claus is Coming to Town — Here Comes Santa Claus — He's a Chubby Little Fellow—Santa, Santa, Santa — Rudolph the Red-Nosed Reindeer — I Wish My Mom Would Marry Santa Claus — When Santa Claus Gets Your Letter — Frosty the Snow Man — Everyone's a Child at Christmas. Rosemary Clooney joins Autry to sing "The Night Before Christmas." (H.A.T.)

★ ★ ★

CHRISTMAS WONDERLAND. Ron Goodwin and his Orchestra. Studio 2 Stereo SCXO 7849.

Interest: Christmas standards in hi-fi.
Performance: Bright.
Quality: Excellent.
Stereo: Excellent.

If you want a collection of Christmas standards, competently arranged and skilfully played, this disc should please you. In addition to the above-mentioned qualities, it has the advantage of the excellent Studio 2 sound. Ron Goodwin is one of the leading names in British light music at the moment, having been responsible for numerous film scores over the past few years. His orchestra has also figured in many fine discs released in the Studio 2 series. Titles are: White Christmas — Rudolph the Red-nosed Reindeer — Silent Night — Sleigh Ride — Little Donkey — Have Yourself a Merry Christmas — The Carol of the Drum — Jingle Bells — Mary's Boy Child — Winter Wonderland — Brahms' Lullaby — The Christmas Song — The Christmas Tree — Medley of Carols. Obviously not for the sophisticated listener, but a good family disc. (H.A.T.)

★ ★ ★

THE OLD SWEET SONGS OF CHRISTMAS. Frank DeVol and the Rainbow Strings. Harmony (Australian Record Com. pany) Stereo HAS 141. Available in Mono.

Interest: Carols with string orchestra.
Performance: Pleasing.
Quality: Good.
Stereo: Two-channel variety.

No less than 28 carols and songs are presented in this selection, pleasantly played and nicely arranged. Released on the low price Harmony label it represents excellent value for money, and the sound is of good quality. The stereo separation is a bit extreme, being firmly split into two channels with no fill in between. Titles include: Ring Christmas Bells — The First Noel — Jolly Old St. Nicholas — Joy to the World — Away in a Manger — Silver Bells — Jingle Bells — Silent Night — White Christmas — We Three Kings — Good King Wencelas — O Tannenbaum — Adeste Fedelis —O Holly Night. Surprise inclusions are Toyland — Skaters' Waltz — March of the Toys. (H.A.T.)

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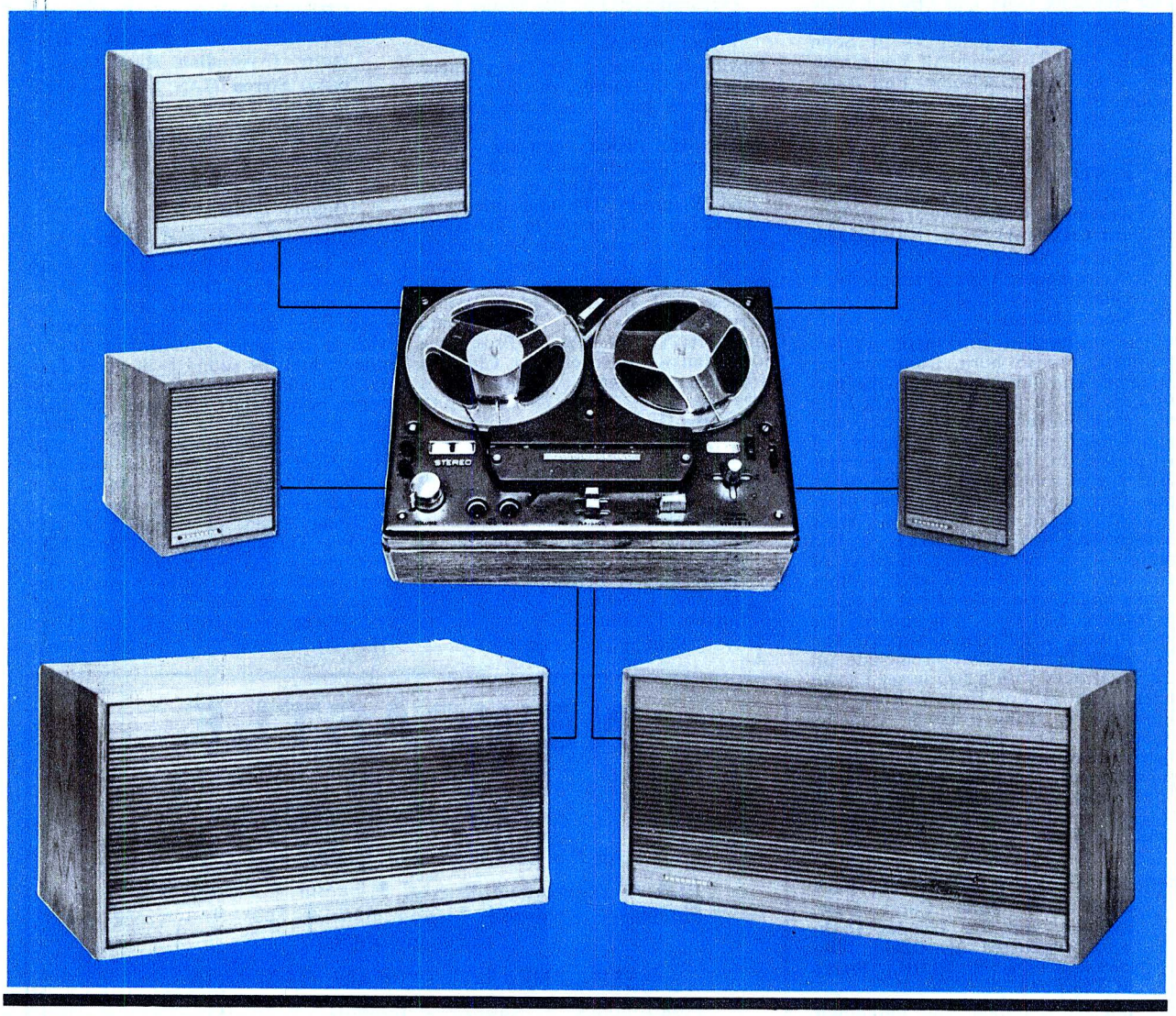

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Instrumental, Vocal & Humour

THE MUSIC OF GUSTAV HOLST. The English Chamber Orchestra conducted by Imogen Holst. World Record Club Stereo S-4373.
Interest: English string classics.
Performance: Delightful.
Quality: High standard.
Stereo: Normal.

This is a most delightful collection of light orchestral works by Holst in a performance which must be regarded as definitive, since it is conducted by the composer's daughter, the foremost living authority of Holst's work. The English Chamber Orchestra is, I believe, drawn from members of the great London orchestras, and their playing here is of very high standard. The program comprises: Lyric Movement for violin and small orchestra—Brook Green Suite from string orchestra — Nocturne from string orchestra —Fugal Concerto for flute, oboe and string orchestra — St. Pauls Suite for string orchestra. Holst may not have been a composer of the top rank, but his work was always elegant and delightfully melodic. World Record Club members are fortunate in being able to obtain this fine disc at the club price. (H.A.T.)

★ ★ ★

SOUVENIR OF GERMANY. Worldwide Series (E.M.I.) Stereo SCXO-6236.
Interest: Travelogue music.
Performance: Expertly done.
Quality: Very good.
Stereo: Good spread throughout.

The title of this disc should give sufficient indication of what it is all about. Folk tunes of various regions are presented by native performers of those regions. Each band or choir appears only once in the 16 tracks, so there is great variety in the program. The 16 titles are all in German, and most are fairly lengthy, so there is not sufficient space to give them all, but here is a translation of some of the shorter ones: The Mill in the Black Forest — I Lost my Heart in Heidelberg — Swabian Maiden — Where the North Sea Waves — Greetings to Kiel — The Fourmaster from Hamburg — On the Weser — Oh Moselle. Quite a round trip, all told, and if you have fond memories of Germany, this disc will surely appeal (H.A.T.)

★ ★ ★

GREENSLEEVES: The Philadelphia Orchestra conducted by Eugene Ormandy. C.B.S. (Australian Record Company), Stereo SBR-235276.
Interest: Famous melodies.
Performance: Has high appeal.
Quality: Good sound, some surface noise.
Stereo: Excellent spread.

In this latest release in the seemingly inexhaustible supply of light classics from Eugene Ormandy and the Philadelphia Orchestra, we have a shortened version of Vaughan Williams' Fantasia on Greensleeves; two of Grieg's Elegiac Melodies (1) Heart Wounds and (2) The Last Spring; an orchestral version of Schubert's famous Serenade; the inevitable "To A Wild Rose" of MacDowell (this seems to turn up on just about every light classic selection recently); the Londonderry Air, seemingly a favourite with Ormandy, as this is the third time he has included it in one of his light classics selections; Intermezzo from "Cavalleria Rusticana"; a Rachmaninoff song without words called "Vocalise"; an orchestral arrangement of that favourite of amateur chorale groups, J. J. Niles' "I Wonder as I Wander;" and the well known "Meditation from "Thais" of Massenet.

A very pleasant collection, and played with all their usual brilliance and richness of tone by this fine orchestra, one of the world's greatest. Why an orchestra of this standard should spend so much of their time recording minor classics is someing of a mystery, but light classics lovers at least should be profoundly grateful. (H.A.T.)

★ ★ ★

DECCA STEREO SAMPLER ALBUM 1968. Decca (E.M.I.) Stereo SXLA 6362.
Interest: Mixed classic and popular.
Performance: Bits and pieces.
Ouality: First rate.
Stereo: Excellent.

As a demonstration of the qualities of the Decca Phase 4 and Deramic recording systems, this disc is convincing enough, but as entertainment the disc leaves a lot to be desired. Side one has all classic material from the Phase 4 repertoire, and although the pieces represented are certainly interesting, and well performed, they are too bitty to be of any use for sustained listening. In five of the seven tracks we get short extracts from major works — not even complete movements in the case of the orchestral pieces — and only the "Exsultate Jubilate" of Mozart and three movements from a Haydn Divertimento have any sense of completeness. The other works represented are Chausson's Symphony in B flat — La Gioconda (Ponchielli) — Poem of Ecstasy (Scriabin) — Piano Concerto No. 2 (Brahms) — Symphony No. 9 (Mahler).

Side 2 is more satisfying as entertainment, and features complete tracks from the Phase 4 and Deramic series. This has The Moody Blues singing "The Morning" — Laszlo Tabor and his Orchestra with "Romany Violin" — Gordon Franks and his Orchestra with "Love in the Open Air" — Ronnie Aldrich and His Two Pianos with the London Festival Orchestra playing "You Only Live Twice" — Engelbert Humperdinck singing "The Last Waltz" — Edmundo Ros and his Orchestra playing Pablo the Dreamer. In view of the widely separated appeal of the two sets of material, and the piecemeal nature of the classics side, I doubt whether E.M.I. will find many takers for this disc at $5.75. (H.A.T.)

★ ★ ★

THESE BONES ARE MADE FOR WALKIN' — Trombones Unlimited. Liberty Records (Festival) Sterio SLYL-932,891. Also in mono.
Interest: Trombones and pop.
Performance: Rather ordinary.
Quality: Very well recorded.
Stereo: Good, even spread.

There seems to have been quite a spate of trombone records recently — prompted, no doubt, by the success of Herb Alpert's Tijuana Brass. But this album really has little to commend it.

Lew McCreary and Dave Wells are the two trombonists involved and they play mainly in unison with the backing of a Mariachi-type rhythm section and female voices. The arrangements are routine and the material, on the whole, is uninteresting. Even attractive melodies like "I Will Wait For You" and "The Phoenix Love Theme" are treated with scant respect.

This is, on all scores, a production-line album suitable only, I would imagine, for party-going trombonists. Even then, the short playing time of 26 minutes would be a sizable deterrent. (T.F.C.)

★ ★ ★

BRASS IN PERSPECTIVE. The G.U.S. Footwear Band conducted by Stanley A. Boddington, L.R.A.M., A.C.R.M. Stereo, EMI Studio 2 SCXO-7865.
Interest: Well known band.
Performance: Dynamic.
Quality: Excellent.
Stereo: Very good definition.

Kettering in Northhampton, England, can claim some distinction as the centre of England's footwear industry

but it is of wider note as the home of the G.U.S. Footwear Band.

In this new album, the Band turns on quite a performance — one that is notable not so much for its ultimate note-for-note precision as for the sheer impact of the total sound. This is due partly to the choice and arrangement of selections, partly to the dynamic playing and partly to the "presence" of the recording itself. The Band is not in a street or glade, or in an auditorium; much of the time they're crowding right into the listening room!

The titles: Sabre Dance — Belle Of The Ball — National Emblem —Puppet on a String—Oh God, Our Help in Ages Past — Colonel Bogey On Parade — The Black Domino — Calling All Workers — Cossack Patrol —Scherzo — O, Listen To The Band —Abide With Me.

One to give your stereo system — and your ears — a thorough workout. (W.N.W.)

★ ★ ★

MISSION: IMPOSSIBLE — Lalo Schrifrin. Dot Records (Festival) Stereo SZL-932786 (also in mono)
Interest: Themes from the TV series.
Performance: Dramatic.
Quality: Excellent recording.
Stereo: Even spread.

Regular viewers of the exciting TV series "Mission: Impossible" will probably recall the very dramatic music which was composed by Lalo Schifrin. Film scores and TV themes rarely result in satisfactory albums but this is only to be expected with functional music of this kind. This album is rather better than average in this regard.

Lalo Schifrin, the Argentinian pianist, composer and arranger, has been a full-time writer in Hollywood since he left the Dizzy Gillespie Quintet at the end of 1962. During his time with Gillespie, he composed major jazz works like "Gillespiana" and "New Continent" and since then he has produced numerous film and TV scores

Schifrin is a mature writer with a highly developed sense of the dramatic. His arrangements can be a little overpowering, but for "Mission: Impossible" this was probably an advantage.

All the pieces are short and the solo features are rather limited. Bud Shank, however, takes nicely rounded alto solos on "Cinnamon" and "Barney Does It All" (the best track on the album); while the composer's piano and harpsichord can be heard on "Operation Charm" and "The Sniper." The playing time is 30 minutes. (T.F.C.)

★ ★ ★

MAGICAL MYSTERY TOUR—Bud Shank. Liberty Records (Festival) Stereo SLYL 932843 (also in mono)
Interest: Pop-jazz.
Performance: Disappointing.
Quality: Bright recording.
Stereo: Even spread.

Bud Shank is undoubtedly one of the finest alto and flute players on the scene today, his major qualities being technical expertise and a very high degree of consistency.

Somewhat surprisingly, he had a sizable hit in the U.S.A. with his version of "Michelle." This follow-up LP has Shank playing, on one side, the tunes from the Beatles' "Magical

ELECTRONIC MUSIC

THE IN SOUND FROM WAY OUT. Electronic music of the future created by Jean Perrey and Gershon Kingsley. Stereo, Vanguard VSD-79,222.

KALEIDOSCOPIC VIBRATION: Electronic pop music from way out by Perrey—Kingsley. Stereo, Vanguard VSD-79,264.

Interest: Musicians and electronics.

Performance: With imagination and patience.

Quality: Very clean.

Stereo: Here, and there and there!

Reaction to these two records will be a strictly individual matter.

To someone like myself, who has spent long years in electronic labs, there is an instant recognition of some sounds, speculation about others and wonderment at the patience of the men who have strung together so many bits to make a precise and coherent whole.

To those with a predominantly musical background, attention will be focused on the arrangement of interplay of sounds, some synthetic, some weird and others more reminiscent of Spike Jones — gone mad.

To still others, it will be plain, stupid noise, quite unrelated to what they are prepared to accept as music.

Without seeking to deny the right to any of these possible points of view, there is no gainsaying that the records combine a lot of electronic know-how, a lot of musical ability, a generous helping of humour and an even greater one of patience.

Some of the sound has come from what the notes refer to as a keyboard instrument — the Moog Synthesiser, paving the way for a remark about the whole thing being a Moog's game! Another whole range of tones comes from the Jenny Ondioline, an instrument capable of producing "a waving, flowing sound." Still other sounds have come from the laboratory, from tiny segments of tape, laboriously pieced together to produce exactly the required pitch and tempo.

Add to these melody lines, the backing of live musicians playing electronic instruments, plus sound effects, real and synthesised, and you have . . . music of the future.

Perhaps it was because I played the records in the order above and had become used to the idea but "Kaleidoscopic Vibrations" gave the impression of laying the emphasis rather more on music and rather less on electronics. Unless you want to be really "Way Out," or don't mind the cost of both albums, you'll probably get more mileage out of "Kaleidoscopic." (W.N.W.)

Mystery Tour," together with five other contemporary pop tunes on the second side of the album.

Unfortunately, the results are rather disappointing, and this applies particularly to the Beatles' side. The musicianship is sound enough with fine players like Chet Baker, Dennis Budimir, Herb Ellis and Victor Feldman in the backing group, but the arrangements by Bob Florence are too tense and dramatic.

More importantly, I feel certain that the Beatles' MMT tunes simply do not lend themselves to this pop-jazz treatment. It is noticeable that the arrangements on tunes like "Windy" and 'I Say a Little Prayer" seem to sit easier in the overall context.

On the whole, this album cannot really be recommended. (T.F.C.)

★ ★ ★

EXOTIC NIGHTS. Andre Kostelanetz and his Orchestra. CBS Stereo SBP 233535. Available in Mono.

Interest: Exotic light classics.

Performance: Scintillating and precise.

Quality: Excellent.

Stereo: Normal.

Andre Kostelanetz has assembled an interesting and unusual program for this disc. The program begins with "Brazilian Dance" by the contemporary Brazilian composer Carmargo Guarnieri, a lively piece filled with the chattering Latin American rhythms. Next comes "Fantasy on Japanese Woodprints," described as a recent work by the American Alan Hovhaness, for xylophone and orchestra, and inspired by old Japanese woodcut prints. The scoring is as delicate and as oriental as the title suggests. Side one ends with more familiar fare, Mussorgsky's "Dance of the Persian Slaves" from his opera "Khovantchina" but even here the oriental atmosphere sustains the exoticism of the program as a whole.

Side 2 opens with part of a work by the almost forgotten American composer Louis Moreau Gottschalk (born 1829). This is the Allegro Moderato movement from his symphony "Night of the Tropics" — not a tremendously exciting work, but interesting and pleasantly tuneful. The next track returns to Japan, with "Sea of the Spring" by the late Michio Miyagi. This beautiful work, evocative of Japan's serenely lovely Inland Sea in the Spring, when the cherry blossom is in full flower, appealed to me as the best of this selection. It features a solo on the koto, described in the sleeve note as 'an ancient Japanese instrument with 13 silk strings." The last piece is "Cordoba" by Isaac Albeniz, from his "Cantos de Espana." This justly popular piece, with its flowing melodies, will be known to most lovers of classical music.

The Kostelanetz orchestra is not of full symphonic stature, but features fine musicians, whose playing is always precise and sensitive. The works presented here are ideally suited to an orchestra of this size, except the Gottschalk work, which was originally scored for a huge orchestra, and is played in a scaled down version here. Sound quality is fine. (H.A.T.)

★ ★ ★

THE DISCOTHEQUE DANCE ALBUM. Calendar (Festival) Stereo SR66-9531 (also in Mono).

Interest: Party music.

Performance: Very successful.

Quality: Superb sound.

Stereo: Well balanced.

As the album title suggests, this is functional music, expressly designed for parties and the like. The excellent

band, under the direction of trombonist Bobby Byrne, features some very well-known musicians like Doc Severinsen (trumpet) Tony Mottola (guitar) and Dick Hyman (organ) — all of whom record regularly for Command, on which label this album was originally released.

The arrangements are appropriately brassy and crisp, the music is gay and the tempos are all danceable. There is also plenty of variety in the tunes, which include "A Taste of Honey," "I'm Henry VIII," "King of the Road" and "Tonight" from West Side Story. One further advantage is that the music is virtually non-stop.

Despite a rather poor playing time of 31 minutes, this album can safely be recommended to serve its purpose. (T.F.C.)

★ ★ ★

FERNANDO GERMANI. Organ recital at Selby Abbey, Yorkshire. Stereo World Record Club S-4329.

Interest: As per title.
Performance: Crisp, capable.
Quality: A few surface crackles.
Stereo: Conservative.

Fernando Germani will need no introduction to anyone with an interest in classical organ. In this recital he uses the instrument in Selby Abbey, a Hill organ installed originally in 1909 and rebuilt by Hill, Norman and Beard during the period 1948-50. The sound is always clear and remains so, even in climactic passages, despite a quite substantial reverberation time for the building itself.

The program for the recital is as follows: Toccata 1 (Frescobaldi)—Canzona Quarto (Frescobaldi)—Concerto In D-minor, BWV 596, Allegro, Largo, Finale (J. S. Bach)—Toccata V (Frescobaldi)—Capriccio Pastorale (Frescobaldi)—Concerto in A minor, BWV 593, Allegro, Adagio, Allegro (J. S. Bach).

The notes contain comment on each item in the recital, on Frescobaldi, Bach and Vivaldi (from whose works the Bach concertos were transcribed) and on the organ itself. Altogether an album to be commended to followers of the classical organ. (W.N.W.)

★ ★ ★

CONCERTO. The London Festival Orchestra conducted by Laszlo Tabor. Solo piano, Wilhelm Davos. Deram (E.M.I.) Stereo SMLA 710.

Interest: Movie classic themes.
Performance: Appropriately good humoured.
Quality: Excellent.
Stereo: Well spread.

I suspect that only the conductor and the solo pianist take this collection of "potted classics" at all seriously. The conductor has previously been associated with palm court type orchestras playing Hungarian gypsy-style music and, no doubt, felt tremendously flattered when asked to conduct so fine a body of players as the London Festival Orchestra. The pianist plods earnestly through his scores while the orchestra hams it up no end. Every one of the tunes has been featured in a film at some time — some having been specially composed for the occasion — but in the main they are themes from well-known classics: Piano Concerto (Grieg) — "Tristesse" Study (Chopin) — Cornish Rhapsody (Bach)—Nuns' Chorus (Strauss)—

LP SPINS AT 45 rpm

EXTRASONIC VOLUME 1. Stereo 45rpm. High Velocity Sound. Concert Recording CR-5033. (From Concert Recording, 10 Caloola Road, Wentworthville, 2145, N.S.W., Australia.)

Interest: Organ "sampler," 45-rpm.
Performance: Leading theatre organists.
Quality: Clean but some surface noise.
Stereo: Normal.

A special point of note about this new release on the Concert label is that it is a 12-inch LP stereo playing at 45rpm — the first I have encountered using this combination of size and speed. The idea, according to the jacket notes, is to secure an extension in high frequency response and a reduction in distortion due to the proportional increase in the wavelengths of all recorded frequencies.

An obvious penalty of using up the groove space more quickly is that playing time must suffer and, while this particular album contains about 24 minutes of program, it does so by running well in toward the label, where the lineal speed advantage compared to the average 33rpm LP must be quite small. In fact, if a 33rpm LP were to concentrate the same program material towards the outside, instead of letting it spread to make the disc look full, the overall advantage in average lineal groove speed might be much less than would at first appear.

A problem that I sensed in watching the disc play is that 12in 45rpm LPs can afford less tolerance to warp than their slower-playing counterparts. An amount of warp near the edge that produces ordinary up and down movement at 33rpm can come close to throwing out of the groove any pickup which has more than a minimum of inertia, as well as increasing the stress on the tiny stylus tube. I had uncomfortable thoughts, too, about a possible increase in stylus wear and extra energy imparted to surface pops.

Quality-wise the disc sounded commendably bright but a comparable Columbia's 33rpm LP of Mr Blackpool (Reginald Dixon) sounded no less so — and with a quieter surface.

All told, it would take more than this record to convince me that the 12-inch 45rpm format is really justified.

As far as the music itself is concerned, the album is a sampler of a dozen conventional 33rpm stereo LPs on the Concert label, featuring what they call "orchestral" organs. "Theatre" organs is the more usual term in this country.

Among the organs recorded are several Wurlitzers, a Compton pipe/electronic combination, a Christie, a Moller, a dual-purpose Hill, Norman and Beard, a Morton, a Marr-Colton and a Wurlitzer/Hammond combination.

The organists include Gerald Shaw, Eddie Weaver, George Blackmore, Bob Van Camp, Douglas Reeve, Jimmy Boyce, Roger Garrett, Don French, Vic Hammett, Dick Smith, Ena Baga, and Dick Schrum — all of them one would judge to be very capable musicians. As you might expect, the actual selections are theatre organ repertoire items.

A very interesting record from several points of view. (W.N.W.)

Rhapsody on a Theme of Paganini, 18th variation (Rachmaninov)—Piano Concert No. 1 (Tchaikowski)—Nocturne No. 2 (Chopin)—The Dream of Olwen (Williams)—Moonlight Sonata (Beethoven)—Piano Concerto No. 2 (Rachmaninoff).

Naturally, only short extracts from the classic works are played here, and I imagine that the bulk of purchasers will be those who are wont to say, "I don't go much on classics, but I like some of the tunes." Those in this category will be well satisfied with this disc, as the orchestra plays in fine style, and the sound quality is of excellent standard. (H.A.T.)

★ ★ ★

THE GREAT ARRIVAL — Sergio Mendes. Universal Record Club. Stereo SU-907.

Interest: Brazilian music.
Performance: very pleasant.
Quality: Acceptable sound.
Stereo: Evenly balanced.

This was the first album which the Brazilian-born pianist, Sergio Mendes, recorded in America (for Atlantic Records) after his arrival there in 1964. It does not feature the extremely popular Brazil '66 group, which Mendes subsequently formed, but it provides an opportunity to hear his piano, backed by big bands under the direction of Clare Fischer, Bob Florence and Dick Hazard.

Mendes is a very able pianist, especially on attractive melodies like Fischer's "Carnival," the Bacharach/David tune "Don't Go Breaking My Heart" and Jobim's "Bonita." I also enjoyed "Tristeza De Amar" and the beautiful ballad "Here's That Rainy Day."

Of the three arrangers represented on the album, Clare Fischer seemed to capture the elegance and melodic beauty of the songs best of all. On some tracks by Florence and Hazard, Mendes' delicate piano playing was slightly overperformed by over-arrangement.

This is an atractive album designed for easy and relaxed listening. The playing time is 32½ minutes. (T.F.C.)

★ ★ ★

IN CONCERT. Ravi Shankar. (sitar) with Kanai Dutta (tabla) and Nodu G. Mullick (tamboura). Liberty (Festival) Stereo SLYL-932,856. Available in Mono.

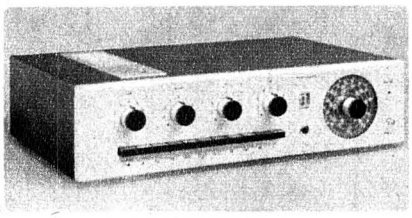
PORTRAIT OF GENIUS. Ravi Shankar, with various supporting artists. Liberty (Festival) Stereo SLYL-932,859. Available in Mono.

Interest: Indian music.
Performance: Enthralling.
Quality: Good standard.
Stereo: Normal spread.

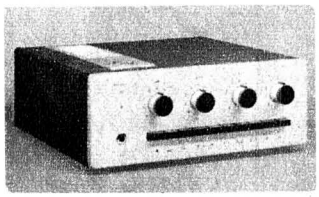
The first disc listed above was made during a tour of the U.S.A. by Ravi Shankar in 1961. Presumably it was issued at that time, and this is a reissue brought about by the present high tide of popularity of Indian music. It features two works, "Madhuvanti" and "Dhun in Mishra Mand." The first is an afternoon raga. After the usual introductory Alap, (rather short in this

ARMSTRONG

Compare an Armstrong with any tuner, amplifier or tuner-amplifier of even remotely comparable price and you will find the Armstrong is not only the best value but the best.



ARMSTRONG MODEL 426 TUNER AMPLIFIER



ARMSTRONG MODEL 421 AMPLIFIER

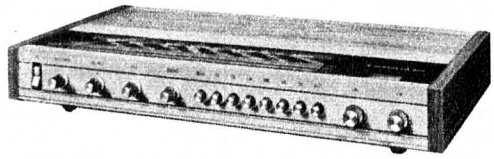
SPECIAL OFFER FOR PRE-CHRISTMAS SHOPPERS

series 400

AMPLIFIER AND CONTROL UNIT SECTIONS 421, 425, 426

RMS Power Output	15 watts per channel, 4 to 16 ohms	
Music Power (IHFM)	20 watts per channel, 4 to 16 ohms	
Power Response	15 watts RMS, 20–20,000 Hz −1 dB.	
Frequency Response	20–20,000 Hz±1 dB	
Harmonic Distortion	Less than 0.5% at 1 kHz measured at 15 watts output±1 dB	
Crosstalk	Better than 40 dB	
Channel Matching	±1 dB	
Bass Control	±10 dB at 70 Hz	
Treble Control	±10 dB at 10 kHz	
Balance Control	Maximum to zero each channel	
Rumble Filter	−5 dB at 30 Hz increasing at lower frequencies	
Treble Filters	1. 6.5 kHz−3 dB, 10 kHz−25 dB 2. 4.5 kHz−3 dB, 9kHz−40dB	
Loudness	At 1 kHz reference (−20 dB) 70 Hz+10 dB, 10 kHz+5 dB	
Tape Recording Output	400 mV Low impedance	
Headphone Output	Suitable for all stereo phones	
Inputs	Sensitivity	Hum & Noise (reference 15W)
Tape Playback	400 mV	−70 dB
Radio (421 only)	100 mV	−60 dB
Pickup 1. Ceramic	60 mV	−55 dB
Pick up 2. Magnetic	3.5 mV	−55 dB

SCHAUB-LORENZ



SCHAUB-LORENZ STEREO 4000

A completely new stereo tuner/amplifier, fully transistorised with impressive performance, remarkable versatility and new distinctive styling.

Four wavebands (VHF/FM, SW, MW, LW), 31 transistors, 17 semi-conductor diodes, 2 rectifiers, transformerless push-pull output. 18-watt output per channel, music power—2 x 25 watt, dimensions—54.4 x 8 x 28 cm, weight approximately 7 kilograms.

For further information write to Recorded Music Salon.

Empire's 999VE–

This is the EMPIRE 999VE as "HIFI/Stereo Review" sees it.

This is also the No. 1 cartridge in lightweight tracking ability as "HiFi Stereo Review" ranks them.

Spectacular no matter how you look at it.

Frequency response, for instance.

"HiFi/Stereo Review" shows it on the 0 dB line of the chart. "High Fidelity" describes it as "a very smooth curve that remains, on the left channel, within plus 2.5, minus 1.5dB, on the right channel, within plus 2.5, minus 2.0dB from 20 to 20,000 Hz."

Or stereo separation.

On the chart above, the lower curve.

In "High Fidelity's"words: "Separation on either channel reaches better than 30 dB at mid-frequencies, and remains better than 15dB from about 30 Hz up to 18,000 Hz."

Or that all-important tracking ability.

"HIFI/Stereo Review" tested and compared all of today's light-tracking cartridges before it raced the 999VE No. 1 "High Fidelity" reported that "the 99VE required only 0.8-gram stylus force to track the demanding bands 6 and 7 of CBS test record STR-120 and the glide tone bands of STR-100."

Add it all up and you reach an inescapable conclusion.

The 999VE is the best all-around stereo cartridge you can buy.

And you don't even have to take our word for it.

Just released in the U.S.A., also available in Australia.

Empire 888VE cartridge.

Technical specifications:

Frequency response: from 6-32,000 cps.

Cutput Voltage: 8.0 mv. per channel.

Channel Separation: more than 30 dB.

Compliance: 30 x 10 minus 6 x cm/dyne.

Tracking Force: ½ to 2 grams.

Stylus: .2 x .7 mil b-radial elliptical hand polished diamond.

Terminating Impedance: 47,000 ohms.

Stylus Replacement: S888VE/ERD Pink.

The price in Australia is almost the same as in the U.S.A.

U.S. price: **$59.90.**

Our Price: **$60.00.**

Made in U.S.A. Sole Agents for Australia: True Fidelity.

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case) Ravi improvises on two main Gat melodies in slow medium and fast Tintal, using a tala cycle of 16 beats. The second work is a lighter style of Indian music, based on folk melodies. To the Indian, this type of music has about the same significance as "light classics" has in the Western musical style. Two tablas are used, first Kharwa with eight beats, then a fast Tintal with 16 beats. The concert took place at the University of Los Angeles, and, although taken live, the audience is quite silent until the almost ecstatic applause at the end of each piece.

The second disc was also recorded during a tour of the U.S.A., but the sleeve notes does not give a date or place. Presumably it is a quite recent recording. Side one has a quite different program from the one on the first disc, being a collection of short pieces, in some of which American flautist Paul Horn plays a prominent part. For the Western listener, the presence of the flute does provide a more easily appreciated melodic line, and it does not sound out of place. The pieces are: Tabla Rasa Ranga, played by flute, sitar, tabla, dholak, kartals and manjira — Dhun (see above) with sitar and tabla — Tabla Dhwani, with a short introduction from the flute followed by a solo display of virtuosity on tablas by Alla Rakha — Song of the Hills, suggesting a lovers dialogue, with flute and santoor intertwining their melodies — Tabla-Tabla Tarang, using a set of tuned tablas — Gat Kirwani, a Dhrut Gat, with fixed melodic line in fast tempo. The whole of the second side is taken up by Raga Multani.

For those fairly new to Indian music, I recommend the second disc rather than the first, for its more easily appreciated melodies and its variety. For more experienced listeners, either disc will make absorbing listening. (H.A.T.)

★ ★ ★

A TRIBUTE TO THREE GREATS. Rosalind Keene. Festival Stereo SFL-932,812. Available in Mono.

Interest: Evergreens.
Performance; Limited appeal.
Quality: Sub-standard.
Stereo: Of a kind.

Despite her limited vocal technique, I understand Rosalind Keene has quite a large following, due to her frequent television appearances. If you are one of those who feel "She has a nice voice" you will probably obtain many hours of pleasure from this disc, despite its drawbacks of mediocre orchestral backing and patchy sound quality. The attractions are a collection of the tunes made famous by Grace Moore, Deana Durbin and Gladys Moncrieff, comprising: One Night of Love — I Was Dreaming Waltzing in the Clouds — Rackety Coo — Beneath the Lights of Home — Love Will Find a Way — Spring in My Heart — Vilja — Stars in My Eyes — My Own — Love Me Forever — My Hero. Those with more sophisticated musical tastes should not bother. (H.A.T.)

★ ★ ★

THE SMOOTH COUNTRY SOUNDS OF REX ALLEN. A U.S.A. Decca recording released by Festival Records. Stereo SDL-932,956 (or Mono).

One of America 's most popular country and western singers, Rex Allen has a fine deep baritone voice and a velvety smooth style ideally suited to this kind of material. His choice of material here also has considerable appeal, including the sad tale of one Jose Villa Lobo Alfredo Vincente Lopez which will find favour with those who appreciate tear-jerking narratives. The 11 tracks include Honey — Tiny Bubbles — Here Comes My Baby — Little Green Apples — Skip a Rope — Am I That Easy to Forget. The Decca recording is of good quality. (H.A.T.)

Popular Jazz

THE BLUE BECHET—Sidney Bechet. RCA Vintage Series Mono LPV-535.

Interest: Bechet at his finest.
Performance: An essential album.
Quality: Sound varies but well remastered.

This Sidney Bechet collection is an admirable sequel to "Bechet of New Orleans" (RCA Vintage LPV-510). The 16 tracks were recorded at seven sessions for Victor—one in 1932 and the remaining six between February, 1940, and October, 1941.

The three tracks (including "Shag") from 1932 featured Bechet's New Orleans Feetwarmers with the trumpeter, Tommy Ladnier. The music is hot and intense with Bechet, as usual, the dominating personality.

The other six sessions collectively included outstanding musicians like Sidney De Paris, Sid Catlett, Rex Stewart, Earl Hines, and Sandy Williams. But, with one exception, Bechet was head and shoulders above his colleagues. He was a natural soloist on soprano and clarinet with his feeling for the blues, his unlimited melodic facility, his haunting lyricism and his intensive drive.

Some of the superb tracks on the album include "Limehouse Blues" and Ellington's "Mooche" and "Mood Indigo." The outstanding performance is the classic "Blues In Thirds" with Bechet on clarinet, Earl Hines on piano and Baby Dodds on drums. This is, quite simply, one of the most beautiful and perfect tracks ever recorded.

With a playing time of 48 minutes, a most informative sleeve note by the late George Hoefer, a price of $3.95 and Bechet at the peak of his form, it is difficult to find reasons why this album should not be part of any respectable jazz collection. (T.F.C.)

★ ★ ★

YOUNG LOUIS "THE SIDE MAN" (1924-27)—Louis Armstrong. Festival Jazz Heritage Series DL 32867 (also in rechannelled "stereo").

Interest: The genius emerging.
Performance: Important collectors' items.
Quality: Acceptable re-masterings.

The 16 tracks and 46 minutes of music on this album are not, it must be said, for the record-buyer with a casual interest in Louis Armstrong. They are, however, of immense interest and significance for the serious jazz collector.

As early as 1924, when the first track on the album ("Word" by Fletcher

Henderson) was recorded, the 24-year-old Armstrong was already an outstanding soloist by any standards and well on his way to revolutionising the concept of jazz trumpet.

These tracks chronologically trace the development in his playing in a variety of settings over the next 30 months. There are, in order, two rare tracks with Perry Bradford's Jazz Phools (in fact, a small Henderson contingent), two rather frantic and exciting tracks with Erskine Tate's Vendome Orchestra, two superb sides by Lil's Hot Shots (The Hot Five) and four each with Jimmy Bertrand's Washboard Wizards and Johnny Dodds' Black Bottom Stompers.

The latter, in particular, are rare and classic sides and Armstrong seldom matched his playing on them for sheer lyricism and beauty.

By the time (April, 1927) Armstrong had just about matured into a most remarkable virtuoso soloist, the complete jazz trumpeter. His playing over these two and a half years is not only interesting historically; it is also thoroughly enjoyable musically.

As usual with the Jazz Heritage Series, the production, including a scholarly sleeve note by Charles Edward Smith, is first-rate. Most collectors will want to add this album to their shelves. (T.F.C.)

★ ★ ★

FIRST IMPRESSIONS VOL 1 (1924-31)—Fletcher Henderson and His Orchestra. Festival Heritage of Jazz Series DL 32868.

Interest: The first of the Big Bands.
Performance: Valuable re-issue.
Quality: Well-remastered.

American Decca's welcome reissue program has now produced a very respectable number of indispensable albums and this Fletcher Henderson volume is no exception. Henderson, an altogether admirable if rather tragic figure in jazz history, led the first (and certainly one of the best) of the big bands.

The first two tracks on this album from late 1924 contain solos by Louis Armstrong but, at that stage, the Fletcher Henderson Orchestra was little more than a commercial dance band. By 1927, however, it developed into a first-class jazz band, featuring some of the leading soloists of the day and crisp, exciting arrangements.

Tracks like "Hot Mustard," "Clarinet Marmalade," "Stockholm Stomp" and "Fidgety Feet," for example, are very close to being classics, with solos by great musicians like Coleman Hawkins, Tommy Ladnier, Buster Bailey, Joe Smith and Jimmy Harrison.

The last five tracks on the album come from 1931, by which time the Henderson Orchestra was probably past its peak and undergoing fairly frequent personnel changes. Nevertheless, tracks like "Sugar Foot Stomp," with effective solos by Coleman Hawkins and Rex Stewart, were still very enjoyable performances.

This album covers the great years of the Fletcher Henderson Orchestra and can be recommended enthusiastically to any collectors with an interest in early big band jazz. As usual, with this series, the presentation is excellent. Playing time is 41 minutes and a helpful sleeve note by Stanley Dance includes soloist identification. (T.F.C.) ■

TRADE REVIEWS AND RELEASES

B.S.R. Record Changer Has Cast Turntable

In our August, 1967, issue, we reported on the B.S.R. UA70 automatic/manual turntable, a fairly low priced unit with a standard of performance which qualifies it for use with good quality audio equipment. Since then, a number of improvements have been made to the original design. In addition, another version, UA75, is now available, fitted with a cast aluminium platter.

For the benefit of readers who have not seen our earlier review of the UA70 we briefly recapitulate the main features of the unit:

Changing mechanism with capacity for up to eight records.
Four speeds, with automatic cycling and shut-off.
Low-mass tubular metal arm with coarse and fine counterweight, adjustment for setting static balance, and dial type adjustment for setting playing weight.
"Cueing lever" for raising and lowering the arm.
Horizontal ball bearing pivots to arm bearings.

The aim of the designers of the UA70 was apparently to provide a unit with characteristics between those of the cheaper commercial units and the more highly priced transcription turntables. Our earlier review concluded that they had succeeded in this. However, we did express some reservations about certain aspects of the performance. We were not happy about the rather heavy set-down of the head in the automatic mode of operation. On the higher operating speeds, this gave rise to noticeable head bounce; for that reason we felt that the UA70 was not entirely suitable for use with magnetic cartridges, when used as a changer, and suggested that users who fitted such a cartridge should use the unit in the manual mode. Another point we raised was the tendency of the cueing device to remain slightly out of its rest position, thereby tending to foul the arm slightly.

In the latest versions of the UA70 both these faults have been corrected. The head lowers smoothly to the disc with no perceptible bounce, and the cueing lever falls right back into place when it is released. Another refinement is that all units are now fitted with an anti-skating device to improve tracking characteristics and also contributing to better stylus life.

Another worthwhile improvement on the latest UA70 is a wider head shell, which will accommodate a wider range of cartridges than the earlier type. Cartridge removal and replacement have also been simplified by the provision of a clip-in type cartridge holder.

Initial installation of the UA70 has also been simplified by the provision of an Amplok connector for the mains input lead, and twin RCA connectors for the audio leads.

The sample UA75 we received for review was not supplied with a matching plug for the Amplok connector, and inquiries with trade houses elicited the information that such plugs are not readily available. However, we are assured by the distributors of the turntables that they will supply a plug and lead with each UA70/75.

In addition to these improvements, and for those prepared to pay rather more, a version of the UA70 can be supplied fitted with a cast aluminium platter in place of the pressed steel platter fitted as standard. Although the manufacturers have not made any figures available, it is reasonable to conclude that this refinement will contribute to improved performance. We commented on slight warping of the pressed steel platter in our earlier review, and although this is not more than is common for pressed steel construction, there was noticeable horizontal deviation. The performance of the cast platter is much superior in this respect. When fitted with this cast aluminium platter, the unit is designated the UA75.

Also fitted to the UA75 (but not to the UA70) is a muting switch which operates during the changing cycle to prevent noise generated by the mechanism from entering the amplifier input; and a "pop" filter to suppress switch arcing when the unit cuts off.

A sample model of the UA75 was made available for review, fitted with a B.S.R. C1 ceramic cartridge. Used in conjunction with a good quality wide range amplifier, the unit produced no noticeable hum or rumble, and we could detect no evidence of wow and flutter. With stylus pressure set to 5 grams, the unit coped well with high frequency and low frequency tracking tests with only slight distortion noticeable at the highest levels in each case. (Project 3 Stereo Test Record SPJL-932,865). When pressure was reduced to 4 grams, obvious distortion was encountered on the highest level, with moderate distortion on the third level. It appears, therefore, that our earlier recommendation of 5 grams stylus pressure is correct, when using the C1 ceramic cartridge fitted as standard. When used with a medium quality magnetic cartridge (Pickering) the unit will track successfully at 2¼ to 3 grams.

Tested with a smooth (grooveless) disc, the anti-skating device proved to be completely effective over most of the arc followed by the head (its efficiency falls off at the outside edge of the disc, for about ¼in of travel). When the stylus pressure and anti-skating calibrations were deliberately made disparate, the arm swung right across the smooth surface of the disc.

The general appearance of the unit can be seen in the photograph. The finish is black and brushed aluminium for the main assembly, while the arm is black and bright chrome. The operating controls are grouped at the bottom front, and consist of a speed selection lever and an OFF, START and REJECT lever.

The UA70 and UA75 are distributed to the trade by Goldring Engineering (A'sia) Pty. Ltd., 443 Kent Street, Sydney, 2000. Owing to the imposition of import duty, the price of the UA70 is rather higher than when we originally reviewed, and it now costs $64.50 retail, fitted with a B.S.R. C1 ceramic cartridge; or $59 without cartridge. For the UA75, the price is $79.50 with C1 cartridge, $75 without cartridge.

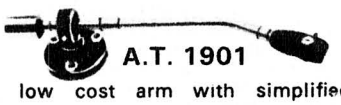
Magnetic cartridges recommended by the distributors are the Goldring 800, selling at $25; and the Pickering V15/AM-3, $26. Users intending to fit other cartridges should check with the distributors as to whether the intended unit can be accommodated in the UA70/75 head shell. (H.A.T.)

AUDIO-TECHNICA

Approach to the Original

"Natural Sound"

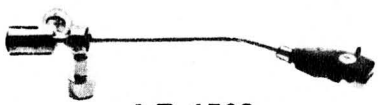
TONE ARMS



A.T. 1901

A low cost arm with simplified mechanism; but maintains precision bearings. Universal type, accepts standard plug-in heads. Direct reading calibration of stylus pressure. Overall length: 275 mm. Tracking error: less than 3°3". Recommended Cartridge Weight: 5.5-17 grams.

List Price: $18.75



A.T. 1503

Specially selected materials are used to manufacture this extraordinarily durable mechanism. Universal type plug-in heads. Calibrated stylus pressure. Overall length: 340 mm. Tracking error: less than 1°55". Recommended Cartridge Weight: 8-28 grams.

List Price: $46.75

ALSO AVAILABLE

A.T. 1005. Universal Type. Standard plug-in heads. 322 mm. arm length. List Price: $37.50.

A.T. 1007. Arm length 330 mm. Accepts Cartridges 3.5-22 grams. List Price: $65.95.

Most people prefer "natural sound". And **natural sound** starts with **Audio Technica.**

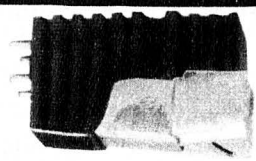
All Audio Technica lightweight pick ups will reproduce the groove, the whole groove and nothing but the groove. This is the reason why **Audio Technica** cannot help sounding natural if the record and the rest of the reproducing equipment are of equally high quality.

Extreme clarity, precise reproduction of transients, complete lack of colouration, vivid presence — **natural sound** is immediately apparent to the listener.

AudioTechnica is used by the leading manufacturers producing a variety of stereo equipment and in hundreds of thousands of homes where people listen to music.

Whether you are amateur, musician or technician, you will appreciate the truly rewarding experience that **Audio Technica** pick ups offer you. They are the closest approach to the original **natural sound.**

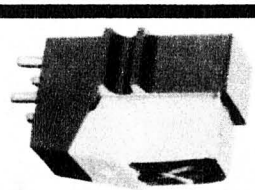
MAGNETIC CARTRIDGES



A.T.-66

DM (Duexciting Magnet) type Stereo Cartridge. Frequency response 20-20,000 Hz. Channel separation: 25 db at 1 kHz. Output voltage 4 mV at 1 kHz. 5 cm./sec. r.m.s. Load resistance 50 K. Tracking force 0.5-2.5 grams.

List Price: $8.50



A.T.-33

VM (V—Magnet) type Stereo Cartridge. Unique wired damper mechanism supports lightweight moving element. Frequency response 20-20,000 Hz. Channel separation 27 db at 1 kHz. Output votlage: 5 mV at 1 kHz. 5 cm./sec. r.m.s. Load: 50 K. Tracking force 0.5-2.5 grams.

List Price: $13.95

ALSO AVAILABLE

A.T. 21S DM type Stereo recommended for low tracking force arms. $11.50

A.T. 35S (spherical stylus) $30.95

A.T. 35X (elliptical stylus) $41.95

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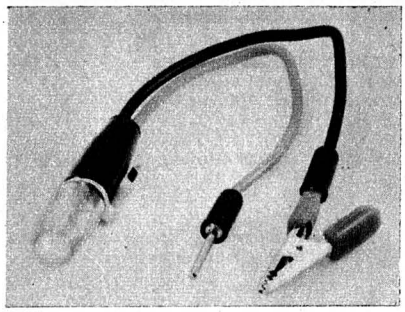
JM/18-68

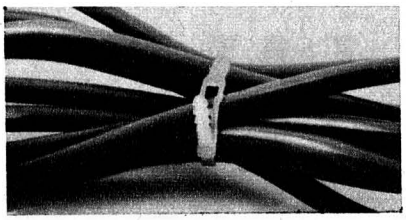
NEON TESTER
NEW CABLE TIDY

Pictured below are two items which should be of particular interest to those involved in any way with mains or appliance wiring.

The first is a small neon type indicator mounted in a plastic housing with pocket clip and with red and black flexible leads. It can be carried in a pocket or loose, as required.

Described as a "Stuart Neon AC-DC Voltage Tester," it will operate on voltages from 100 to 500 AC or DC. In normal





use, the red lead, terminating in an insulated alligator clip is clipped to an "earth" and the black lead terminating in a small probe touched on the expected "live" circuit.

For use with ordinary 240V AC mains outlets, the lamp will light if the probe is pushed into a live socket outlet with the alligator merely held in the hand. In this respect, it behaves like an ordinary probe tester and it is quite a simple matter to determine the polarity of a socket and whether or not it is live.

The second item is the "Adjusta Tie" a 6¾-inch length of flexible plastic, moulded with a slot in one end and serrations along the remainder of its length. It can be looped around wiring, etc., the serrated end pushed through the slot and pulled up tight. It will lock in any desired position but can be undone in an instant and re-used. Any number of segments can be joined together if a single one is not long enough. The Adjusta Tie is ideal for temporarily tying up appliance leads or for use with looms of bulky wiring.

Sold normally in 100 lots, the Adjusta Tie can also be put to many non-electrical uses, such as for tying up plants in the garden. Being unaffected by exposure, they can be adjusted as necessary and recovered after use.

Both items were submitted for review by Radio Parts Pty Ltd., 562 Spencer Street, Melbourne. 3000.

TAPE LIBRARY REOPENS

The Australian Tape Recording Society has reopened its Tape Library Service which was discontinued in mid-1968 because of business difficulties. Details of this service can be obtained from the Secretary, A.T.R.S., Box 9, P.O., Crow's Nest, N.S.W. 2065.

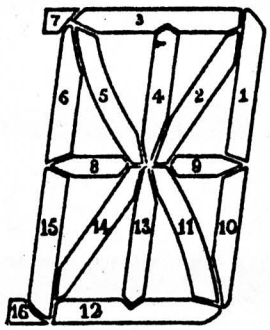
ELECTROLUMINESCENT PANELS FROM DUCON

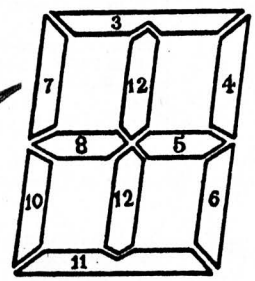
Ducon Condenser Pty. Ltd., are Australian agents for a U.K. manufacturer of electroluminescent panels. Small stocks are available for prototype evaluation and quantity supplies can be arranged against specific orders.

Electroluminescent panels are suitable for display lighting, alpha-numeric readout devices, training diagrams, including simple forms of animation, as marker lights in photographic darkrooms to pick out obstacles, pinpoint controls, etc., and a great many other industrial applications.

The electroluminescent panels are available, to order, in virtually any size a— manufacturer may care to nominate. They are also available as stock items in the form of a numeric display panel (10 segments) and an alpha-numeric display

A typical panel designed for use in commercial darkrooms. It measures 4in x 1in and gives a green light.





Two display units. The upper one is an alpha-numeric type, the lower one a numeric type, but which can also present some letters. Connection is via a multi-pin assembly at the rear.

panel (16) segments. The numeric panel can display all numbers from 0 to 9 and some letters. The alpha-numeric panel can display all numbers and all letters of the alphabet.

The panel may be energised directly from the 240V, 50Hz mains and will withstand voltage surges up to 100 p.c. over voltage. Operation at higher frequencies, up to 400Hz, gives a proportional increase in light output. In a typical case an output of 1ft/lambert at 240V, 50Hz is increased to 8ft/lamberts at 240V, 400Hz. Operation above 400Hz may damage the units.

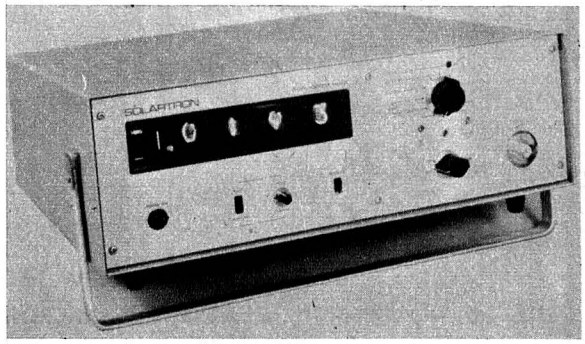
The panels have a minimum life of 10,000 hours, lit time. Electroluminescent panels normally suffer a short decline in light output during the early part of their life, but thereafter decline very gradually. These panels are aged to eliminate the rapid initial change.

The panels are available in four nominal emission wavelengths, and are kept within ± 5 p.c. of these values. They are: orange (5900°A), red (6500°A), green (5100°A) and yellow (5700° A).

The panels will withstand vibration normally encountered in buildings housing machinery, will operate between 40°F and 120°F, and 40 p.c. to 90 p.c. relative humidity. No form of failure will produce spurious light likely to damage photographic material.

Further technical details, price structure, delivery times, etc., may be obtained from the Professional Components Dept., Ducon Condenser Pty. Ltd., P.O. Box 2, Villawood, N.S.W., 2163.

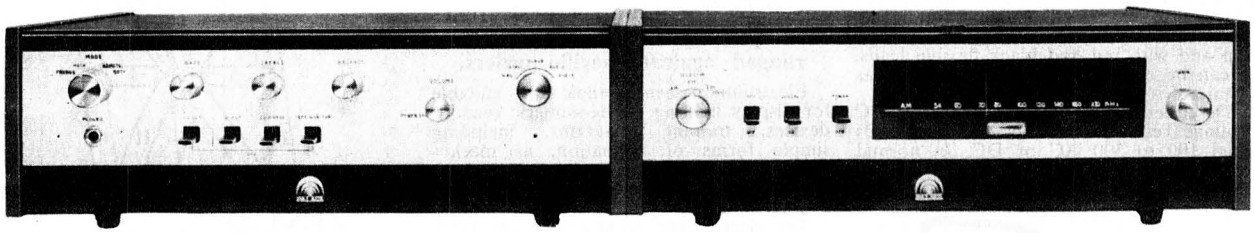
Solartron Low-cost Digital Voltmeter



Very high sensitivity and good noise rejection capabilities are features claimed for a new Solartron high accuracy, low-cost digital voltmeter. The instrument has a scale length of 11,000 with an automatic over-ranging facility which enables voltage to be measured "on the decade" with full resolution. Readings from 2.5uV to 1,000V in six ranges can be obtained at a rate of 25 conversions a second. Accuracy is plus or minus 0.01 per cent of the reading.

Calibration against an internal Weston cell can be set with a five figure resolution. The rejection of spurious noise is greater than 150dB for common mode interference signals and integration techniques minimise series mode interference. An added feature is the high input impedance of greater than 10,000 megohms. Plug-in options give remote changing of sensitivity and fan out data logging system applications.

DELUXE ALL-SILICON SOLID-STATE STEREO EQUIPMENT BY PALACE FOR DISCERNING MUSIC LOVERS —POWER—CLARITY—TRUE-TO-LIFE SOUND



PALACE SOLID-STATE STEREO AMPLIFIER Model AM-333

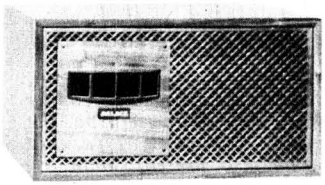
Output Power:	60 Watts IHF (30 Watts RMS) into 8 ohms 72 Watts IHF into 4 ohms
Distortion:	Less than .8% at rated output
Frequency Response:	20 to 20,000 Hz ±.5 dB
Input Levels:	Phono (Magnetic) 2 mV Phono (Ceremic) 70 mV Aux 200 mV
S/N Ratio:	60 dB
Controls:	All standard controls including speaker selection switch

FEATURES:
IC hybrid circuits in preamplifiers, extremely wide frequency response range, high damping factor for dynamic presence, remarkably distortion-free

PALACE SOLID-STATE AM/FM/MULTIPLEX TUNER Model RA-333

Frequency Range:	FM88 to 108 MC AM535 to 1605 KC
FM Input Sensitivity:	1 Microvolt for 20 dB S/N ratio
Image Ratio:	60 dB
Stereo Separation:	25 dB
AM Input Sensitivity:	400 Microvolts for 20 dB S/M ratio
Image Ratio:	40 dB
Antenna Input Impedance:	300 or 75 ohms

FEATURES:
Stable Hi-Fi reception without frequency drift, tuning meter, speaker switch for extra speakers, high reliability due to print-board circuitry, extremely low harmonic distortion



Model S-776

Frequency Range:	50 to 21,000 Hz
Maximum Input:	25 Watts (matched to output of Model AM-333)
System:	3-way—PM dynamic woofer and squawker, and cellular horn tweeter

FEATURES: Extremely broad response range, elegant fretwork grille.

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ITOKA PRODUCTS CORPORATION

No. 1-4, 3-chome, Mita, Minato-ku, Tokyo, Japan.

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HI - FI (STEREO) PTY. LTD.

STATE SAVINGS BANK HOUSE, Mezzanine Floor, 157 Elizabeth St., Melbourne, Vic. 3000—67-3263

PERPETUUM EBNER PE-2020 AUTOMATIC TURNTABLE

A relatively new name to the Australian audio field is that of Perpetuum Ebner, from West Germany. The PE turntable featured in this review is the top of the line of their automatic changers and has just about every operating feature one could wish for. It was submitted complete with a Shure magnetic cartridge and wooden base with one-piece injection moulded transparent dust cover.

The PE2020 photographed on it matching base but with the transparent cover removed.

A few years ago, most audio enthusiasts shied away from record changers because of the damage they reportedly caused to records. However, with the very much more refined designs now available, many people find the new automatic players and changers desirable, because they enable the use of low tracking weight cartridges without the need for a steady hand—necessary with the usual manual turntable not fitted with a lowering device.

The base plate of the new PE 2020 automatic player/changer is of pressed steel over which is bonded a layer of aluminium. This has a brushed finish which is also used on the arm and the aluminium ring inset in the turntable. This "sandwich" construction of the base plate is claimed to damp resonances as well as providing an attractive finish.

The turntable itself is a zinc diecasting with a diameter of 11 inches. It is dynamically balanced and weighs more than seven pounds, which makes for a good flywheel effect to damp out any small speed variations. The rubber matting is firmly cemented to the turntable. This last point may seem trivial but, on some turntables, the matting is glued at a few points around the periphery and tends to buckle after a period of use.

The turntable is driven by a four-pole induction motor which has the usual four steps on its shaft to provide the four playing speeds. Each of the steps is tapered slightly to provide fine speed adjustment as the idler wheel is lowered or raised by the vernier speed control. This gives an adjustment of about 3 per cent either way. The idler wheel, which is the main factor determining the rumble content in a turntable of this type, is unusually pliant. The idler is automatically disengaged when the motor is switched off.

The dynamically balanced pickup arm is fitted with an elastically mounted counterweight which enables cartridges weighing from 3 to 15 grams to be used. Tracking weight is adjustable from 0 to 6 grams in half gram steps by means of a dial at the base of the arm. The graduations are accurate to within 10 per cent. The tracking force is actually applied by means of a spring which means that the arm is not set "out of balance." On the other hand, the tracking weight can be expected to vary according to the height of the record stack but, in practice, the variation does not exceed about 10 per cent of tracking weight setting.

Anti-skating compensation is applied automatically along with the tracking weight. Further small adjustments can be made to the anti-skating to allow for different stylus size and shape and for "wet" or "dry" playback—a manufacturer's term which refers to whether or not an anti-static fluid is being used. These adjustments are made by a dial to the left of the base of the arm and are facilitated by a comprehensive table in the operating manual.

A unique feature of this turntable is the facility for adjusting the vertical tracking angle of the stylus. This is effected by a small knob at the front of the pick-up head, which has settings from 1 to 8. It changes the angle of the cartridge mount to give a compromise vertical tracking angle to suit the stack of records when used in changer mode. The correct setting is equal to half the number of records on the stack. An important feature of this facility is that it enables the cartridge to be adjusted so that it does not foul the records when playing a large stack.

For the vertical tracking adjustments to be correct, the cartridge must set in the arm so that the arm is horizontal when playing a single record. This can be accurately set by means of a plastic gauge which fits over the slide-in pick-up head. This gauge also is used to set the stylus overhang. Although the head is claimed to be suitable for all cartridges having the standard ½-inch mounting centres, the above-mentioned gauge cannot be used with cartridges which have a very deep cross-section.

Once the initial adjustments mentioned above have been made, actual playing operation is very simple — using the speed selector and the lever on the right-hand corner of the base-plate which controls Start, Stop, Lift and Lower. The player can be used as a single-play turntable or as a fully automatic changer. Two spindles, one long and one short, are provided for the respective modes of operation.

In use, the player functions very quietly and rumble, wow and flutter are negligibly low. The cartridge is lowered and raised very gently at all speeds, the action being mechanically operated from the main cam. The player can be used with the highest quality cartridges at tracking weights below one gram if need be, and still function flawlessly.

As mentioned earlier, the turntable was supplied for review complete with base and dust cover. The top of the base is finished similarly to the base plate of the record changer and incorporates a compartment which is covered by a sliding door — very tidy. This can be used to store all the inevitable accessories that one accumulates—spare cartridges, record cleaners, etc.

The dust cover is a one-piece injection moulding of clear plastic. It can be simply and completely removed from the hinges at the rear. The hinges also enable the cover to be suspended at any angle. One minor disadvantage of the cover is that it cannot be closed when the record changer is being used with the long multi-play spindle.

All in all, the turntable is a well planned and well engineered piece of equipment which can be bracketed with the best hi-fi units. The retail price of the player without cartridge is $164. The base and dust cover retail for $58. Other accessories such as preamplifiers are available to suit. The unit was submitted for review by the N.S.W. distributors, Atram Pty. Ltd. (5 McClaren St., Sydney), on behalf of the Australian agents, Gunter Griep, 14 Inglewood Ave., Forest Hill, Vic., 3131. (L.D.S.)

TRADE RELEASES—in brief

AUSTRALIAN GENERAL ELECTRIC PTY. LTD. has introduced the PA436 monolithic, phase control, integrated circuit. This device is intended for use as a triac triggering circuit for resistive and inductive loads. Its power supply is derived directly from the AC line and it requires only six external components for complete operation. The circuit offers ramp and pedestal operation, adjustable gain, and low power dissipation. The circuit also has an inhibit function which prevents premature gating of the triac when used with inductive loads and establishes a minimum triac blocking voltage before gating. Inquiries to the company at 103 York Street, Sydney, 2000.

DISTRIBUTORS CORPORATION PTY. LTD. has introduced a range of Darstan wire-wound resistors for current control or heating purposes in battery charger circuits, instruments, voltage droppers, voltage dividers, etc. These open-wound resistors consist of a glass fibre core on which a resistance wire is spirally wound. Resistance values range up to 300 ohms per inch of active length. Power ratings are 5W per inch of active length for uninsulated resistors and 3W per inch for insulated resistors. Standard tolerance is plus or minus 10 per cent. Further information may be obtained from the company at 24 Johnston Street, Fitzroy, Vic. 3065.

SOANAR ELECTRONICS PTY. LTD. is marketing a range of sub-miniature epoxy silicon rectifiers manufactured by I.T.T. The rectifiers feature a one-amp rating at 25 degrees C with PIVs from 50V to 400V. The surge rating is 50 amps, while the reverse current is less than 10uA. The insulated case is moisture resistant. These attractively priced rectifiers are available through normal trade channels. Trade inquiries to the company at 82 Carlton Crescent, Summer Hill, N.S.W. 2130.

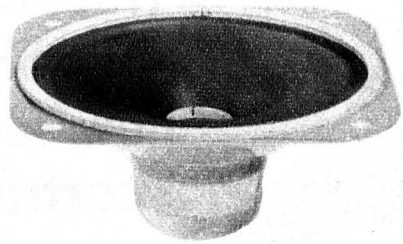
(Continued on page 132)

NATIONAL ORGAN

Japanese organist Miss Noriko Sugibayashi gave a series of special organ recitals at the Japan Trade Centre, Sydney, to promote a new electronic organ produced by National. Miss Sugibayashi toured all Australian States making numerous TV and in-store appearances to promote the organ, which is being distributed in Australia by Haco Distributing Agencies Pty. Ltd., 57-69 Anzac Parade, Kensington, N.S.W., 2033.

ROLA TWEETER TYPE 3DX

The Rola Company has announced the release of a 3½-inch tweeter, designated type 3DX. It is intended for the general high fidelity market but, in particular, is a companion unit for the Rola 6-inch "woofer" type C-650, mentioned in the July, 1968 issue of "Electronics Australia."



Conforming to what is now accepted practice, the 3DX has a sealed cone housing, allowing it to be mounted, without complication, in the same enclosure as the bass loudspeaker. It uses a single cone of very light construction and of curvilinear shape, to ensure a sustained frequency response.

The 3DX is currently being offered in two values of voice coil impedance: 8 ohms and 15 ohms.

As with other tweeters, low frequency audio must be prevented from reaching the 3DX and it must therefore be fed through a suitably chosen series capacitor. In loudspeaker systems described by "Electronics Australia," using simple L/C crossover networks, it has been our practice to roll off the signal fed to 3-inch tweeters at about 5KHz. This has typically involved a series capacitor of 4uF for an 8-ohm tweeter and 2uF for a 15-ohm tweeter. These values would be appropriate for the new Rola 3DX, although smaller values might conceivably be stipulated where the tweeter is being used simply to brighten the top end of a system not including a series inductor to the bass unit.

Listening tests on the loudspeaker were conducted with a Playmaster "Point-4" enclosure, with the tweeter paired with a Rola C-650 woofer, and A-B tested against the original "Point-4" prototype.

The general sound level and balance of the two systems were very similar indeed and any differences were of such an order that they could not possibly have been noted except in a direct switch-over in the middle of a music passage, or a white noise signal.

Separate tests indicated that the response of the 3DX remained substantially at reference to above 12KHz. Beyond this, a downward taper was evident, but plenty of output was still available to the limits of audibility.

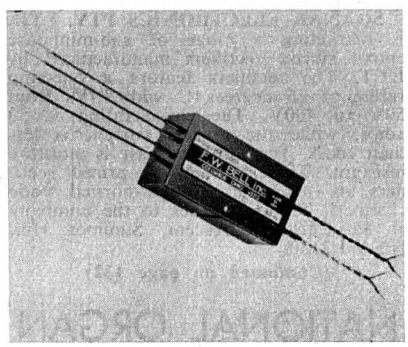
We have no hesitation, therefore, in commending the new 3DX tweeter for use in our Playmaster "Point-4" system, or in any other situation where a 3-inch tweeter is called for.

The makers advise that the 3DX is available through Rola outlets. (W.N.W.)

SOLARTRON AUSTRALIA has released details of the A.1613 Digital Multimeter, manufactured by a sister company in the Schlumberger Group, Rocher of France. Functions measured are AC and DC voltage, AC and DC current, resistance and capacitance. The ranges of measurement are from 100uV (least digit) to 1000V, 0.1uA to 2A, 0.1 ohm to 2Mohms, and 0.1pF to 2uF. Accuracy varies from 0.1 p.c. of reading on DC voltage to 0.3 p.c. of reading on capacitance (all reading subject to plus or minus 1 digit). The input is fully isolated from chassis and offers 130dB common mode rejection. Polarity determination and display is automatic. Inquiries to Solartron Australia, 112 High Street, Kew, Vic. 3101.

GENERAL TELEPHONE AND ELECTRONICS (A'ASIA) PTY. LTD., a subsidiary of GT and E International Incorp., has changed its name to Sylvania Electric Australia Pty. Ltd. A spokesman of GT and E International said the change was made so that the name of the company would clearly indicate that it is engaged in marketing Sylvania products in Australia.

F. W. BELL INC., of Columbus, Ohio, U.S.A., has added a new versatile wattmeter transducer to its line of Hall effect devices. The HX-2000 series is a high-precision, solid-state line of wattmeter transducers which provide a DC output directly proportional to AC power. The



One of the HX-2000 series of wattmeter transducers from F. W. Bell Inc.

power computation is performed instantaneously by a single Hall effect multiplier, which is epoxy potted in a unitised nylon case. Complete details and specifications may be obtained from the Australian agents, Tecnico Electronics Pty. Ltd., P. O. Box 12, Marrickville, N.S.W. 2204, or branches in all States.

AUSTRALIAN GENERAL ELECTRIC PTY. LTD. anounces two additions to its range of integrated circuits. The PA189 is a low-cost high-gain IF amplifier/discriminator housed in a plastic dual-in-line package. It is intended for the consumer/industrial markets and may be adapted to meet a variety of TV and FM requirements. The PA237 is a monolithic audio amplifier designed to deliver 2 watts of continuous power to a 16-ohm load. Housed in a 8-lead, plastic dual-in-line package, it has an attached tab for heat transfer to a printed circuit board. The PA237 can be used with a wide variety of supply voltages and load impedances, and may also be used for voltage regulator and servo amplifier applications. Inquiries to the company at 103 York Street, Sydney, 2000.

PAINTON (AUSTRALIA) PTY. LTD. has moved from Richmond to larger premises at 29 Railway Avenue, Huntingdale, Vic., 3166. The new telephone number is 569-0931.

FAIRCHILD AUSTRALIA PTY. LTD. has introduced the uA741 high performance monolithic operational amplifier.

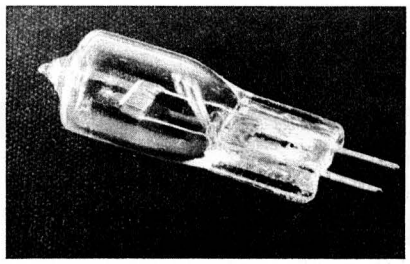
It is the successor to the uA709, and is a pin-for-pin replacement for it but requires no external components for frequency compensation. The uA741 can withstand indefinite short circuits to ground or either supply, because the output stage is current limited. The uA741 is available in a TO-99 package with a temperature range from minus 55 degrees C to plus 125 degrees C, and costs $22.50 in small quantities. The uA741C is similar but has a temperature range from 0 to plus 70 degrees C and is available in a T0-99 package for $10.50 or in a dual-in-line package for $11.25. Inquiries to the company at 420 Mount Dandenong Road, Croydon, Vic., 3136.

STANDARD TELEPHONES AND CABLES PTY. LTD. has appointed Sir Samuel Jones as chairman. He will continue in his capacity as Managing Director of the company, a position he has held since 1961.

VITRANOM PTY. LTD. has introduced a high-speed, high-reliability, mechanically actuated switching module said to eliminate detectable bounce and to vastly reduce noise. The device offers ring-free switching up to 6000 closures per second with a life approaching 100 million closures. Low actuation pressure (40 grams max.) and movement differential (.005in max.) make it ideal for mechanical ganging, motion detection, data and telemetering instrumentation, etc. For further information contact the company at 534-536 Prince's Highway, Rockdale, N.S.W. 2216.

PLESSEY COMPONENTS GROUP, in the U.K., is now in quantity production with a range of fluid logic elements, including a number of input/output devices and other accessories, plus complete mounting and manifolding hardware in addition to the logic elements. A universal mounting system has been designed to simplify the construction of fluidic circuits. The units simply plug together and can be interconnected in a variety of ways. The system enables prototypes to be built quickly and is also suitable for the construction of production assemblies. Further information may be obtained from the Professional Components Department, Ducon Division, Plessey Components, Villawood, N.S.W. 2163.

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir St., Glen Iris, Vic. 3146, has announced a DC to 40GHz digital frequency measurement system. The system, E40-524L, is said to represent an improvement in performance and ease of operation over previously available systems of this type. It consists of standard, general-purpose instruments, each of which can be used separately for other tasks. The instruments in the E40-524L are: a DC to 50MHz electronic counter with a 50MHz to 18GHz transfer oscillator plug-in; a 2 to 4GHz local oscillator (a versatile general purpose plug-in sweep oscillator); a synchroniser for phase-locking the local oscillator to CW input signals; a mixer; a 20dB directional coupler; and a monitor tee.



RADIO DESPATCH SERVICE would like us to remind readers that for some time now they have been maintaining regular stocks of the popular "BOFA" range of projection and specialised incandescent lamps, which offer long life and high performance at a low cost. Recent additions to the Japanese-manufactured BOFA range include a series of tungsten-halogen lamps, with types available for most equipment designed around these lamps. Pictured is the lamp at the top of the range, rated at 24V 250watts. Enquiries regarding the quartz-halogen series or any other lamps in the BOFA range may be directed to the above firm at 868 George Street, Sydney, 2000.

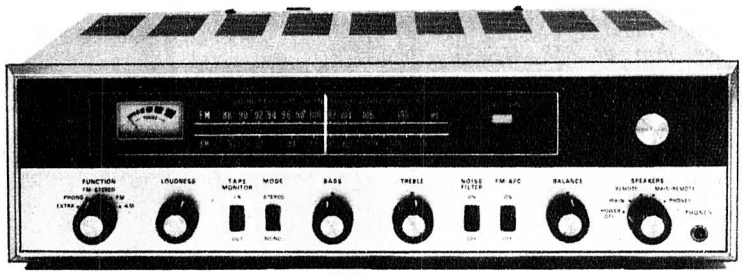
DYNAMCO ELECTRONICS PTY. LTD. has recently signed an agreement to become sole Australian distributors for Raytheon Computer of Santa Ana, California, U.S.A. The main product is a flexible general purpose digital computer, type 703. Available with core stores ranging from 4000 to 32,000, an access time of 1.7uS, and 16 bit word length, the 703 is obtainable in a wide range of configurations starting at $15,000, including input/output machine. A full range of peripherals includes disc store, high speed printer, magnetic tape store, A-D and D-A converters, multiplexers, etc. For further information, contact Dynamco Electronics Pty. Ltd., 90 Alexander Street, Crow's Nest, N.S.W. 2065.

NORTON CO., U.S.A., has developed a silicon carbide element laboratory furnace which can provide working temperatures up to 2900 degrees F in air or an inert atmosphere. Called the NRC LV500 series, the new furnace provides fast response and uniform heating, and allows the use of its tubular element as a work chamber. The elements are available with inside diameters of 2 or 3½in, and heated lengths to meet uniform temperature zone requirements. Standard temperature uniformity is plus or minus 20 degrees F. Applications include semiconductor processing, brazing, sintering and outgassing in the electronics and metallurgical industries. The Norton Co. is represented in Australia by Norton Australia Pty. Ltd., Nyrang Street, Lidcombe, N.S.W. 2141.

HEWLETT-PACKARD CO., of the U.S.A., has introduced a double-balanced mixer, model 10534C, that has 0.1in connector pin spacing in two rows 0.3in apart—the same as standard flat-pack ICs. Although not an IC, the mixer is packaged in a subminiature enclosure only 0.35 x 0.4 x 0.4in. The package houses a four-diode bridge and two toroidal transformers. The hot-carrier diodes in the bridge are matched to give high carrier suppression—mixer balance is claimed to be at least 15 to 35dB

monarch:
the miser

Penny-pinching cannot be condoned where hi-fi's concerned. Except . . . where the customer is perhaps just a beginner in the stereo world, or even a man-on-a-budget. He has to be miserly with his money, he has to limit himself to a medium price range, yet he'd like the finest equipment available in this price range. This is where Monarch Amplifiers excel. The three models below represent the best value for anyone's money: the highest possible standard of fidelity at a medium — **you could call it miserly — price!**



MODEL SAT-460X
Solid State AM/FM Mpx Stereo Tuner Amplifier

Transistors:	32 transistors, 19 diodes.
Output Power:	26 watts per channel at 8 ohm (IHF).
Frequency Response:	20-25,000 Hz ± 0,5 db.
Controls:	Tuning, Loudness, Balance, Bass, Treble.
Switches:	Input selector, speaker selector (with power switch), tape monitor, noise filter and FM-AFC.
Input:	Mag-Phone 3mV, Extra 200mV, Tape-in 200mV for maximum output.
Dimensions:	16¼" (W) x 4½" (H) x 11" (D).
Weight:	18 lbs.

MODEL SAT-260X
Solid State AM/FM Mpx Stereo Tuner Amplifier

Transistors:	22 transistors, 17 diodes.
Input:	Mag 2.5mV X-tal, 170mV Aux. 230mV for maximum output.
Output Power:	13 watts per channel at 8 ohm (IHF).
Frequency Response:	20-20,000 Hz ± 1 db.
Controls:	Tuning, volume, balance, bass and treble.
Switches:	Function, tape-monitor, mode, scratch filter, FM-AFC and loudness
Dimensions:	4" (H) x 14½" (W) x 10½" (D).

MODEL SA-500
Solid State Stereo Amplifier

Transistors Used:	Total: 14 transistors, 6 diodes.
Pre-amplifier:	
Equalizer:	"Mag" RIAA.
Sensitivity:	"Mag" 3mV at 1KHz; tuner 150mV at 1KHz. "Ceramic" 30mV at 1KHz.
Power Amplifier:	
Power Output:	15 watts/channel IHF.
Frequency Response:	20-20,000 Hz ± 1 db.
Output:	4, 8 and 15 ohms (Tapeout for tape recorder).
Dimensions:	10¾" (D) x 4¼" (H) x 13½" (W).
Weight:	13 lbs.

Sole Australian Distributors

W.C.Wedderspoon Pty.Ltd.

193 Clarence Street (between King and Market), Sydney. 29 6681

Available from

N.S.W. Stereo Music Systems, 193 Clarence Street, Sydney.
Magnetic Sound Industries, 387 George Street, Sydney.
Edels Pty. Ltd., 88 King Street, Sydney.
Kent Hi Fi, 432 Kent Street, Sydney.
A. Victor & Co., Cnr. Elizabeth St. and Wentworth Ave., Sydney.

QLD.: Modern Dictating, 555 Stanly Street, South Brisbane.
VIC.: Danish Hi Fi, 941 Burke Road, Camberwell, Melbourne.
W.A.: Musgroves Ltd., 223 Murray Street, Perth.
Alberts TV, 282 Hay Street, Perth.
Alfreds Emporium, Pier and Hay Streets, Perth.

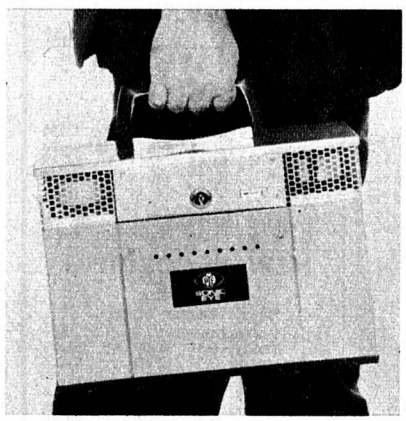
depending on frequency range. The mixer has a frequency range from 50KHz to 150MHz on two ports and from DC to 150MHz on the third. Conversion loss is only 6.5dB from 0.2 to 35MHz and 8dB over the whole frequency range. The low frequency noise is less than 0.1V per root cycle at 10Hz. Inquiries to the Australian company, Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

NARDA MICROWAVE CORPORATION, of the U.S.A., has available a precision coaxial phase shifter which provides variable phase shift over at least 180 degrees. The new unit, Model 3753, covers the frequency range from 3.5 to 12.4GHz. Phase shift, in degrees per GHz, is indicated directly on a digital counter on the front panel, with an accuracy of plus or minus 0.30 degrees per GHz. The unit can handle 200 watts average, and has a VSWR of only 1.3 over most of the range. Inquiries to the company at Commercial Street, Plainview, N.Y. 11803, U.S.A.

RCA MAGNETIC PRODUCTS LTD. has been formed to manufacture tape and other magnetic products in Great Britain for the British and overseas markets. The new company is 75 per cent owned by RCA Great Britain Ltd., the wholly owned British subsidiary of RCA, and 25 per cent owned by International Computers Ltd. It is planned to construct a factory at Bryn Mawr in South Wales, which is expected to start operation in 1970.

KENNEDY COMPANY, of the U.S.A., has added two new models to its range of computer-compatible recorders. Model 1400/360 is a low-cost recorder capable of writing IBM System 360 compatible tapes from sources of medium-speed data. It records a nine-track 800 BPI format with a standard recording speed of 0-500 bytes per second. Model 1600 is a low cost recorder using IC techniques. Tape format is IBM compatible, seven track with packing densities of 200 or 556 BPI. For further information, contact the Australian distributors, Dynamco Electronics Pty. Ltd., 90 Alexander Street, Crow's Nest, N.S.W., 2065.

PYE PTY. LTD. has developed a low-cost portable intruder alarm, known as the Pye Sonic Eye. It is intended to help prevent crimes by frightening away would-be intruders. When switched on by a removable key, it fills the area to be protected (surrounded by four walls) with a sonic field of high pitched sound inaudible to the human ear. Any interference with this field, even opening a door to a very slight degree, sets off an alarm horn within the unit which gives a prolonged blast, audible at long distance. This blast continues until the interference ceases or the unit is switched off by its key. For further information contact the company at Clarinda Road, Clayton, Vic. 3168.

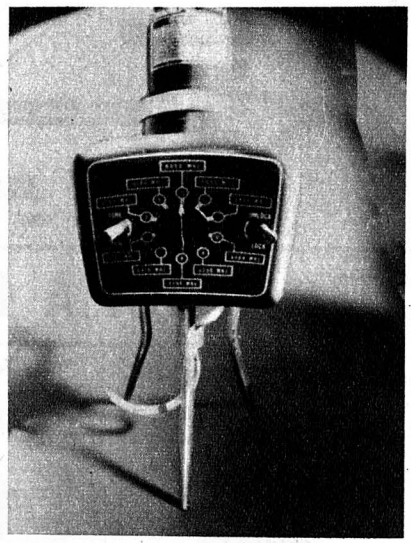


The relatively light weight (22lb) of the Pye Sonic Eye means it can be easily moved between locations. It can be operated from mains power or from its own rechargeable batteries.

AUSTRALIAN GENERAL ELECTRIC PTY. LTD. has announced the company's range of ICs for industrial and consumer electronics. The range available includes: PA424 — zero voltage switch; PA230 — low level amplifier; PA223 and PA238 — operational amplifiers; PA222, PA234 and PA237 — audio amplifiers; PD455 — bistable frequency divider; PA436 — phase control; PA189 — IF discriminator. For further information contact the company at 103 York Street, Sydney, 2000.

EMERSON & CUMING INC., Canton, Massachusetts, U.S.A., is manufacturing a lossy ferrite as tiles 1in square and 1/8in thick. Known as Eccosorb ZN, it is used to damp surface waves and creeping waves in a variety of UHF and microwave devices. It is a ceramic and may be used over a temperature range from -65 to 1,000 degrees F, and is completely weatherproof. The attenuation varies from 17dB/cm at 200MHz to 26 dB/cm at 10GHz. Further details may be obtained from the Australian agents, Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W. 2208.

SOLARTRON has developed a range of high accuracy, high stability domain transducers. The first, a Vibrating Tube Liquid Density Meter, model NT 1762, is shortly to be followed by a Vibrating Cylinder Gas Density Meter, model NT 1792. The output from the meter is an FM signal which is detected and converted to a direct density reading by an associated read-out unit. The two-tube design of the NT 1762 provides continuous on-stream measurement of density with flow in either direction or with the liquid at rest. Features of this transducer include 0.1MG/cc accuracy and good long term stability. Inquiries to Solartron Australia, 112 High Street, Kew, Vic. 3101.



Fish-eye lens view of the Varian automatic channel tuner.

VARIAN ASSOCIATES has developed an automatic channel tuner available as an optional extra with Varian CW or pulse klystrons. The tuner permits changing passbands in four seconds by selector switch. Up to 12 channels are available from one klystron. Each channel provides the usual klystron bandwidth, typically 1.0 per cent, 1dB, and each can be set to a different centre frequency. Normally, centre frequencies are selected so that the channels span the entire 4 to 10 per cent potential tuning range inherent in most klystrons. For further information, write to Varian Australia Pty. Ltd., 38 Oxley Street, Crow's Nest, N.S.W., 2065.

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BOOKSHELF ENCLOSURE
Maple, Teak or Walnut
Complete $24.75
SUPER BOOKSHELF $36.75.
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CABINETS ONLY
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MULLARD $10.95

BOOKSHELF UNITS

6in	8in	10in	12in
$27.75	$33.50	$35.50	$36.50

GUITAR AMPLIFIERS

10-Watt, Two-Channel, with Twin Cone Speaker $53.55
14-Watt, 4 Inputs, Bass and Treble Boost. 2 Twin-Cone Speakers, $63
17-Watt, Four-Channel, Bass and Treble Boost. Two Twin-cone Speakers $76.25

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin-Cone Speakers .. $109.05
Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato control included.

$163.50

SLAP BASS OR BASS GUITAR 40-WATT AMPLIFIER
4 Input Channels. Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

$159.75

PIGGY BACK GUITAR AMPLIFIER

30 Watt $79.75
45 Watt $99.75
60 Watt $119.75
4 Inputs. Bass and Treble Boost. Vibrato if required, $10.50 extra.

ELECTRIC GUITAR

Pickup Units $8.75
Accordion Pickup Units .. $8.75
Harmonica Pickup Units .. $1.95
Post, N.S.W. 40c; Interstate, 75c.

FUZZ BOX

FUZZ BOX E. AND A. AUG. WIRED AND TESTED. $15.
Post., 75c.

REVERB UNIT

COMPLETE with AMPLIFIER. E.A. October issue. Kitset $39.95. Wired and tested, $41.95.

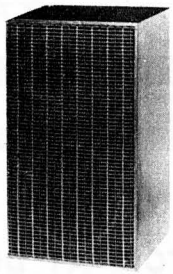
15-INCH HI-POWER SPEAKER

30 and 50-WATT RMS. Specially designed for Guitar, Organ, Bass, etc.

$30.00

INTER. COM. UNITS

2 Station Transistorised
$11.95
4 Station, including Master
$20.95



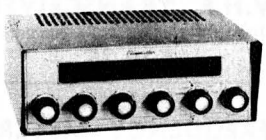
"MYERS" AUTOMOBILE STEREO TAPE PLAYER

12 VDC. 1 amp operation. Size 3, 4 and 8 track cartridges can be played. Automatic starting and selecting. 12 silicon transistors. Freq. response. 70-10,000 cps. Tape speed 3¾" per sec.

$99.50

240 VAC model available, includes P.U. or radio input. $99.50

PLAYMASTER 106 AND 107



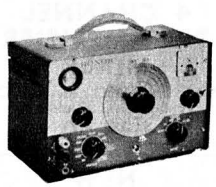
Feb. and March Elect. Aust.

106
WIRED AND TESTED $94.75
107
WIRED AND TESTED $83.75

10 + 10 STEREO AMPLIFIER

E.A. November.

Kit Set $59.75
Wired and tested $69.75



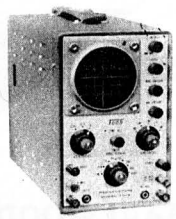
T. E. 46 RESISTANCE-CAPACITANCE

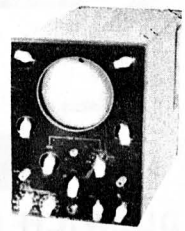
Bridge and Analyser. Capacity 20 pf to 2,000 mfd. Resistance 2 ohm to 200 megs. Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.

Indications by eye and meter.

$49.75

TEST EQUIPMENT





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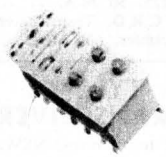
5 Meg. Bandwidth Push-pull vertical and horizontal Amplifiers, 8 positions, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $102.75; 5-inch $118.75

PLAYMASTER 115

The new solid state Stereo-Amplifier. April issue.
Wired and tested $104.00
Kit Set $90.00
Pre-amp to suit magnetic cartridge 12.00



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BSR deck with parts for transistor pre-amp and circuit.

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Easy to build. Hi-Fi quality.

TAPE DECKS B.S.R.

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240v A.C. POWERED SOLID STATE STEREO

T.S.135
18 Transistor. 15-watt per channel. Inputs for Tape. Mag. P.U. Ger. P.U. Radio Aux. Frequ. Range 30c to 20KC. Max Sensitivity 3 MV. Speaker matching 4 to 15 ohms.

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5 WATTS PER CHANNEL.
Valve Unit. 240v A.C. Input for Crystal and Ceramic P.U. Radio and Auxiliary. Output for 4, 8, 15 ohms. Cross talk better than -40db. Sensitivity 50 MV.

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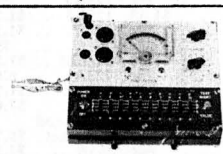
UA 41A - 20-20

SOLID STATE STEREO
20 watts per channel. Inputs for tape, magnetic and ceramic P.U. Tuner and aux. Teak cabinet.

$88.00



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Tests all valves, diodes, rectifiers, checking filaments, shorts, Merit on direct reading. Good-bad meter. Complete with tube chart.

$27.75

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SIGNAL INJECTOR

Transistorised. Fountain pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service.
$5.75. Post. 25c.

TRANSISTOR AND DIODE TESTER

E.A. August, '68.
Wired and Tested.
$57.00
KIT SET $48.00

TECHNICAL BOOKS AND PUBLICATIONS

Amateur radio

AMATEUR RADIO TECHNIQUES by J. Pat Hawker, G3VA. Second edition 1968. Stiff paper covers, 160 pages, 9½ x 7 inches. Published by the Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1.

If I had to offer advice about this book in two words, it would be easy: "Buy it!"

The brainchild of well-known technical writer Pat Hawker, the book is largely a collation of material published over the years in the R.S.G.B. Bulletin under the title "Technical Topics," The first such collection appeared about three years ago as "Technical Topics For The Radio Amateur" and, as such, it may be known to many readers of these columns.

Despite its rather miscellaneous heritage, the new book gives the impression of being very well organised.

Section 1, involving the first 25 pages goes under the heading "Semiconductors" and in it is compressed as good an introduction to the subject as one could wish for. Mind you, it is not written for those who are completely uninitiated technically but it will suit admirably the reader who has picked up a general technical background "in the old days" and needs an introduction to these all-pervading new-fangled devices! The presentation is such that it carries its own urge to read on.

Then follows a shorter section on "Components and Construction" containing, among other things, further practical information about discrete and integrated semiconductors.

Section 3, "Receiver Topics" is another 30 pages, packed with circuit diagrams, illustrating receiver principles and configurations, segments, stages, ideas and what-have-you. Many of the ideas are taken from, and credited to, technical journals, among them being the "Deltahet" receiver, devised by our own staff member, Ian Pogson, VK2AZN.

Remaining sections cover "Oscillator Topics," "Transmitter Topics," "Audio and Modulation," "Power Supplies," "Aerial Topics" and, finally, "Fault-Finding and Test Units." All these are packed with information which should keep the average amateur absorbed for hours—and days and weeks! All told there are over 350 diagrams to be mulled over.

Our copy of the book came direct from the publishers, the R.S.G.B. itself, at the address quoted above. Price in Britain is a modest 12/6. No information is available at the moment as to local price and availability but we imagine that it will find its way into local technical booksellers and possibly the Wireless Institute of Australia. Whatever the source, it is worth seeking out. (W.N.W.)

Servicing

MODERN ELECTRONIC TROUBLE-SHOOTING, By the authors of Electronic Technician/Dealer. Published by TAB Books, Blue Ridge Summit, Pa. U.S.A. Soft covers, 5½in x 8½in, 256pp., numerous diagrams and photographs. Price in Australia, $6.15. Hard cover, $9.95.

According to the preface, this book is intended to assist the service technician in the practical skills and techniques of servicing. The editors emphasise that the best service technicians are not necessarily well versed in the theory of circuit operation. "Their keen diagnostic skills are the result of developing and using test procedures which most rapidly expose the cause of a signal malfunction", to quote them exactly.

Granted, they concede that "...a service technician certainly must know his basic electronics..." but one could be pardoned for imagining that, in this book, theory plays only a minor role in servicing and that "Up-to-Date Test Instruments and Advanced Servicing Techniques (to quote the subtitle) is the main secret of servicing success.

In fact this is not so, and anyone expecting to be given some magic path to instant servicing, will be disappointed. It would appear that the authors have set a fairly high standard on their definition "...well versed in the theory of circuit operation"; a standard more akin to that of the engineer.

Thus, chapter one, "Checking Diodes and Transistors" delves almost immediately into the technique of using a CRO to trace characteristic curves of these devices. The description of the technique concludes, "If the scope you use is calibrated, the dynamic collector resistance can be computed and the transistor linear range determined". Which isn't a bad start for a book which, superficially, appears to be devoted to an essentially "practical" approach.

However, in spite of this — or perhaps because of it — the book does appear to have made a very good job of putting into print the kind of things real life serviceman encounter in their everyday work, and the experience they gain from them. It's theme would seem to be that any serviceman will do a better, quicker job if he has modern test equipment available and learns how to use it. And, in today's competitive market, this is all-importent.

The book is divided into five sections: Troubleshooting Solid State Equipment; Troubleshooting Colour TV Circuits; Troubleshooting FM/Stereo Equipment; Troubleshooting Two-way Radio Equipment; and Test Instruments and Applications. In all, 23 chapters.

It would be impossible to list the title of every chapter, but some idea of the subjects covered can be gauged from the following. Section one covers printed circuits, capacitors, transistor TV, radio, and hi-fi/stereo. Section two covers colour servicing procedure, video circuits, high voltage problems, and diagnosing with a CRO. Section three: principles of FM/stereo, hi-fi test instruments, and tape recorders. Section four: technical and legal test instruments, narrow band FM, volume limiting, CB equipment, and noise figures. Section five: CRO triggersweeping, RC bridge, test probes, and test equipment maintenance.

While some of the subjects are not relevant to the Australian scene — or, at any rate, not yet — most of the book would seem to contain a lot of valuable information, based on the experiences of a large commercial servicing organisation. In these circumstances it would be surprising if even the most experienced serviceman did not find at least a few valuable time and moneysaving suggestions. For the less experienced it should contain a lot of valuable information.

Our copy from Grenville Publishing Co. Pty. Ltd., Anthony Horderns Building, Pitt St., Sydney 2000 (P.G.W.).

N.A.B. Conference

TECHNICAL PAPERS PRESENTED AT THE 1968 N.A.B. ENGINEERING CONFERENCE. Published by TAB Books for the National Association of Broadcasters, Washington D.C. Soft cover (spiral binding), 11in x 8½in, 254 p.p., numerous photographs and diagrams. Price in Australia, $12.40.

This is a complete transcript of the conference, including the technical papers and a transcript of the FCC/Industry Panel discussion. It contains reproductions of all the photographs, slides, and drawings presented in conjunction with the technical papers. These technical papers, by engineers specialising in each particular field, may be regarded as presenting the current state of the art of the subjects covered.

The following list of paper titles gives some idea of the diversity of the subjects discussed:

Dual Reliable AM Transmitter System; Digital Frequency Monitoring For AM/-FM/TV; Automatic Logging of Directional Antenna Parameters; Galvanised Steel and Paint Specifications For Towers; A New Circularly-Polarised FM Transmitting Antenna; Aspects Of Audio Testing; Optical Multiplexing Theory and Practice; A Modular Portable Lighting System; Processing Techniques for Correction Of Video Signal Defects; New Developments in TV Measuring Techniques; Colour Video Switching Systems; Plumbicon Colour TV Equipment; The New WAGA-TV Facility; A New Portable Camera; New TV Measurement Techniques Using Existing Studio Monitoring Equipment; Review of VHF-TV Remote Tests; Radio Automation Workshop; TV Automation Workshop; and FCC/Industry Panel.

For anyone engaged in the technical side of broadcasting, particularly TV, this book would appear to be extremely valuable. This is the more so since the discussions of TV equipment and facilities almost invariably concern colour techniques, even though this may not be apparent from the index. Since colour is something the local industry is going to have to face up to in the not-too-distant future, the more background material available the better.

While the papers deal with their problems and subjects in some depth, they are not necessarily so complex that the average technical person could not read them and acquire a good deal of useful information.

Our copy from Grenville Publishing Co. Pty. Ltd., Anthony Horderns Building, Pitt St, Sydney 2000. (P.G.W.).

Integrated circuits

ELECTRONICS HOBBYIST'S IC PROJECT HANDBOOK, by Bob Brown and Tom Kneitel. Published by Tab Books, Blue Ridge Summit, Pennsylvania, U.S.A. Hard covers, 8½in x 5in, 159pp. Numerous circuit diagrams. Australian price $8.70, Soft covers $4.95.

According to the literature accompanying this book it describes ". . . how electronics enthusiasts can become familiar with ... integrated circuits." I suppose it all depends on how one defines "become familiar" but as far as this book is concerned, it would seem to be confined to recognising the pin numbers by which these devices are connected into a circuit.

American constructional projects in general never seem to be overburdened with the theory of operation, preferring instead to concentrate on how-to-build-it instructions, preceded by a suitable sales blurb. Even so, this book must set an all time high (or low), even in its country of origin, for what it doesn't say. As for assisting enthusiasts to become familiar with ICs, this reviewer considers that this is precisely what it does not do.

There is a brief introduction, about five pages, presumably intended to put the reader in the picture in regard to ICs. Several photographs depict their physical form, but the text is so brief that it could have little real meaning for anyone not already well versed in the subject.

From here the book plunges straight into the constructional projects, the first one being a 6 to 11 metre short-wave receiver. This apparently is regarded as one of the larger projects, being given two and a half pages; one page for the text (including the title), one for the circuit, and half for the parts list. Lesser projects rate between one and a half and two pages.

As if this were not enough, the circuits themselves call for the ultimate in blind faith. The ICs are portrayed simply as a circle of numbered pins connected to the external discrete components. There is nothing to indicate what the IC contains and, therefore, how the circuit functions. The only concession in this regard is that the circuits of the ICs are presented in the back of the book, but this form of presentation hardly seems to fit in with the concept of familiarising the beginner with a new technique. The situation is made worse by the fact that some ICs are portrayed using conventional solid state circuit symbols, and some by logic symbols. Presumably they have been reproduced just as received from the manufacturer.

This criticism is not directed at the circuits themselves, but rather at their portrayal. Indeed, it may well be that many of them would turn out to be worthy suggestions, if only one could see at a glance how they are supposed to function.

As far as the Australian reader is concerned, there is the additional complication that he would have to satisfy himself that a reasonable number of the ICs suggested were available on the local market—and at an acceptable price.

In the circumstances, not particularly recommended.

Our copy from Grenville Publishing Co. Pty. Ltd., Anthony Horderns Building, Pitt Street, Sydney, 2000. (P.G.W.)

Reference book

ELECTRONIC ENGINEER'S REFERENCE BOOK, Third Edition, by the late L. E. C. Hughes and F. W. Holland. Published by Heywood Books, Iliffe Books Limited, London, 1967. Hard covers, 5in x 7½in, 1532 pp., many illustrations. Price in Australia $22.00 plus postage.

The third edition of Dr L. E. C. Hughes' well-known reference work, with final editing performed after the original author's death by F. W. Holland. And even more so than with the first edition published in 1958, it represents a veritable cornucopia of reference data for the designer of electronic — mainly industrial electronic — equipment.

Of course no single book, not even one such as this with more than 1500 pages, could hope to provide "all necessary reference data" for a field of endeavour as comprehensive and far-reaching as electronics. Nor could such a book hope to remain fully up-to-date in a discipline so dynamic, especially if it has a commitment of more than 1500 pages . . . Despite these very real qualifications the "EERB" is able to provide a surprisingly comprehensive and relevant body of reference material, and should thus prove of considerable value particularly to those concerned with the efficient design of industrial electronic equipment.

Notable and quite intentional exclusions from the book are major topics such as radar, radio and television, telecommunications, and wave filters; these fields are in any case covered quite well by such books as Radio and Television Engineers' Reference Book (Newnes), Radiotron Designer's Handbook (AWV Co.), Radar (Pitman), and so on. Those fields which are covered in the present work include

information theory, nuclear instrumentation and techniques, metrology, infra-red and ultra-violet radiation, lamps and lighting, photoelectrics, RF induction and dielectric heating, high voltage and X-ray equipment, non-destructive testing and reliability testing, valves and transistors, vacuum techniques, magnets and supermagnets, ultrasonics, acoustics, computing and automation.

Not a book for the beginner or hobbyist, to be sure, as much of the material presented is reference data rather than explanatory text; however, for those engineers and technicians seeking a design reference, a volume which merits close inspection.

Our copy came from the Technical Book Company, of 289-299 Swanston Street, Melbourne, 3000, who advise that copies are already in stock and available on mail order if desired. (J.R.)

TV servicing

MODERN TV CIRCUIT AND WAVEFORM ANALYSIS. By Stan Prentiss. Hard covers, 256 pages, 8½in x 5in. Illustrated with waveform photographs, explanatory circuits, typical commercial circuits, troubleshooting charts, etc. Published by TAB Books, Blue Ridge Summit Pa. U.S.A. Price in U.S.A. $7.95.

Basically, this book is aimed at the practical serviceman and, as its name implies, describes servicing procedures based on analysis of individual sections of the circuit and the waveforms they produce. It is obvious that the author believes that the CRO is the most useful single piece of test equipment for TV servicing, and that this fact is overlooked by a large percentage of servicemen. The book is therefore intended to familiarise the reader with typical waveforms as they are encountered in commercial receivers, and to explain how to interpret these in terms of a set failure.

There are 10 chapters in the book, titled as follows: 1, Basic Waveforms. 2, RF-IF Circuits. 3, The Second Detector and Video Amplifier. 4, Noise, Synch and AGC. 5, The Vertical Deflection System. 6, The Horizontal Deflection System. 7, The Audio System. 8, Power Supplies. 9, Chroma Circuits. 10, Troubleshooting Solid State Circuits.

From the above list it might be inferred that colour and solid state techniques are confined to the last two chapters. In fact, each chapter considers both the thermionic and solid state versions of the particular receiver section, making a handy comparison for those still trying to orientate their thinking toward the newer techniques.

In regard to colour, the author emphasises that this now represents the greatest sales volume and that, with the exception of chapter one, the book is based largely on colour techniques. While of little practical value in Australia at the moment, information on colour techniques will attract those who wish to prepare themselves for its eventual appearance in this country.

Each chapter commences with a brief discussion of the operating principles of the stage concerned, then goes on to list the most common fault symptoms, typical waveforms, and likely causes. Naturally, it is impossible to list every likely fault, etc., and no attempt is made to do so. All the author aims to do is to familiarise the reader with the various stages and their waveforms, to the point where he can make his own diagnosis.

Unfortunately, while the aim of the book is a good one, it falls down by reason of some unfortunate mistakes and a tendency to oversimplify explanations. For example, in the chapter on video amplifiers, the description of a typical solid state video amplifier is rendered largely useless by reason of one complete stage being missing from the circuit drawing. And, in the same chapter, the comparison between valves and transistors is oversimplified almost to the point of being misleading.

However, provided the reader does not expect the discussions of basic principles to do anything more than refresh his memory, and is prepared to back them up with more specialised text books, the book could still prove useful. In particular, it should help bridge the gap between valves and transistors, which the local trade is already experiencing, and give some insight into the problems of colour which will have to be faced in the future.

Our copy direct from the publishers. (P.G.W.)

LITERATURE—in brief

STANDARDS ASSOCIATION OF AUSTRALIA has published AS B275 Metric Screw Threads for Fasteners. This is the first standard in the screw threads field to be prepared primarily on the basis of Australian industry's requirements, and it is also the first to deal exclusively with the I.S.O. metric screw thread. Copies of AS B275 are available from the various offices of the Standards Association for $1.40 each.

(Continued on page 143)

NOTES AND ERRATA

POWER SUPPLY FOR MODEL TRAINS (April, 1968): Under certain conditions of operation, involving near maximum load on the silicon bridge network (BYX21-200) when connected to the minimum (11V) transformer tap, excessive current is drawn through the LT91 rectifier. This is best avoided by connecting the LT91 rectifier to the 11V tap rather than the 18V tap. This still provides adequate power for the "Auxilliary Supply" terminal and the "Battery Charging" terminal, the only modification required being a reduction in the resistance in the charging circuit. This will probably involve removing the existing 50 ohm resistor, leaving the 50 ohms (approx.) of the lamp to limit the maximum safe current through the battery. This is quite adequate.

THE 10-PLUS-10 STEREO AMPLIFIER (November, 1968): Recent information to hand from the Miniwatt Electroncis Division of Philips Electrical Pty. Ltd., indicates that the BZY95-C30 zener diode should be replaced with a BZY95-C27 to give a greater safety margin in the case of mains supply and temperature variations. This will reduce the maximum available power output slightly but this will not be enough to affect the performance audibly.

RADIO - INTERCOM (October 1968): The circuit on page 53 has a small error of omission. The second and third lugs of the local speaker switch should be connected together, so that in the "monitor" position the speaker remains connected to the output of the audio section.

250W SSB TRANSMITTER (April, 1967): In the parts list, two 10K ½W resistors are required and a 2000uF 10VW electrolytic should be added.

PREAMP FOR ELECTRIC GUITARS (October, 1968): Coded photograph, p. 69. The 220K resistor in the emitter circuit should read 220 ohms.

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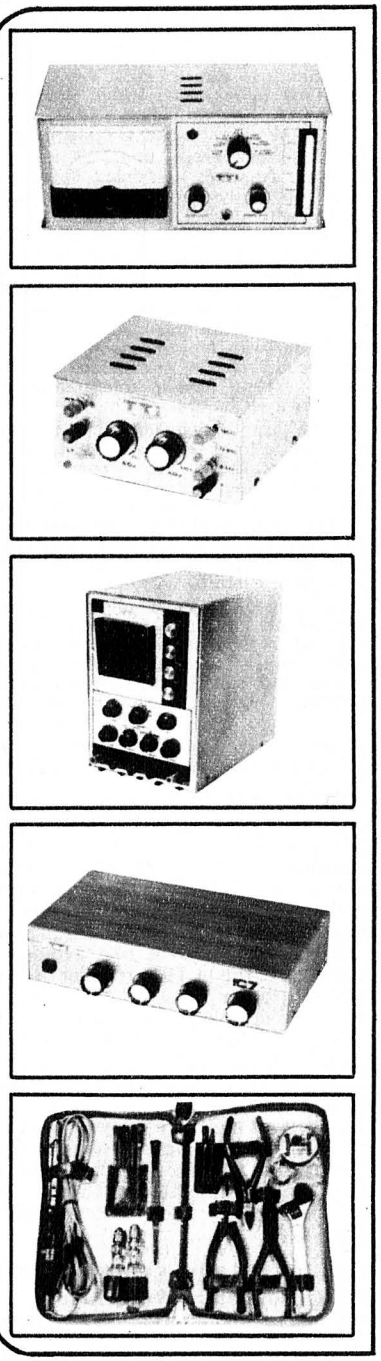

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NATIONAL BUREAU OF STANDARDS of the U.S.A., has announced the following publication:

Tabulation of Published Data on Soviet Electron Devices through October, 1967, by Charles P. Marsden. N.B.S. Technical Note 441, issued July, 1968 (supersedes Technical Note 265), 89 pages, price 55c US. This is a tabulation of published data on Soviet electron devices collected from publications issued by the various ministries and institutes of the U.S.S.R.

This is the fourth revision and expansion of Technical Note 265, published in October, 1965, and includes more than 200 new types of electron devices.

Copies of this publication may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Remittances must be in U.S. exchange, and should include an additional one-fourth to cover mailing costs.

HEWLETT - PACKARD JOURNAL, Vol. 19, No. 12, August, 1968, includes the following articles: Fully Calibrated Frequency-Domain Measurements: Analyser/Tracking-Generator System; Design of a Third-Generation RF Spectrum Analyser; New Concepts in Signal Generation; Units Ambiguity Noted. The Journal is published by the Hewlett-Packard Company, Palo Alto, California. Inquiries should be addressed to the Australian associated company, Hewlett - Packard Aust. Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

NEW DEVELOPMENTS, issue B039, October, 1968, the new products guide published by Jacoby, Mitchell & Co. Pty. Ltd., includes the following:

Grundig closed circuit TV systems;
Telonic plug-ins;
Sweeney electrostatic transistorised voltmeter;
Electronic Instruments ultrasonic electrode cleaner;
Sony magnetodiodes;
Advance static inverters;
Sanders fixed coaxial attenuators, and frequency meter;
Weinschel barretters and thermistors;
Gossen meters;
Shinkoh automatic null balancing indicator.

Inquiries to Jacoby, Mitchell & Co. Pty. Ltd., 469-475 Kent Street, Sydney, 2000.

LASER CONTRACTS DIRECTORY, 1963-1967, is a fully indexed reference book which catalogues the cumulative U.S. Government contract experience of some 300 divisions of private companies, universities, and other research establishments active in the laser field. It includes summary descriptions of more that 1200 contracts arranged by company and division. These are indexed in depth for rapid retrieval by laser applications categories, awarding agencies, and by states. The Laser Contracts Directory is available from Carrollton Press Inc., 1647 Wisconsin Avenue, Washington, D.C. 20007, U.S.O., for $US45 post paid.

MULLARD OUTLOOK, Vol. 11, No. 4, July-August, 1968, has the following items: Viewpoint with Mullard: Audio Circuits Using Lockfit Transistors; Mullard Exhibits at U.K. Exhibition; Vacuum Gauges for Industry and Research; Flexible Timer Using TAA320 Integrated Circuit; Silcon Rectifier Diodes; Stereo 10-10 Transistor Power Amplifier; Infrared Microscope: New Magnetrons for Radar. Mullard Outlook is published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2001, to who all inquiries should be addressed.

KODAK (AUSTRALASIA) PTY. LTD., has published a pamphlet, No. P-128, containing information about Kodak Metal-Clad Plate N. This is a multi-layer product designed for the microelectronics mask maker who requires a very durable photomask for contact printing onto resist-coated silicon wafers. The plate consists of chromium-coated glass, overcoated with a photo-sensitive resist, which is essentially Kodak Thin Film Resist. Copies of the pamphlet may be obtained from Kodak branches in all States.

THE MICROPHONE, Vol. 4 ,No. 1, October, 1968, the official journal of the Australian Tape Recording Society, includes the following articles: All "Sony" Studio; Hi-Fi Dictionary; Theoretical and Practical Appreciation of High Fidelity; Microview — Recording Tape Review; The A.T.R.S. Tape Library; Insight — World Record Club. Inquiries to the Society at Box 9, P.O., Crow's Nest, N.S.W. 2065, or Box 1707P, G.P.O., Melbourne, Vic. 3001.

DRY REED SWITCHES describes the theory, construction and characteristics of dry reed switches and reed relays. Intended to assist users, it includes selection charts for the range of B & R dry reed switches. Published by B & R Relays Ltd., Harlow, Essex, England, copies of this 30-page booklet may be obtained by applying on company letterhead to the Australian agents, Electrical Equipment of Australia Ltd., 75 Liverpool Street, Sydney. 2000.

SIEMENS REVIEW, Vol. XXXV, No. 7, July, 1968, has the following contents: Expansion of Raisting Earth Station for Operation with Intelsat III; Telegraph Signal Analyzer for Distortion Measurements on Teleprinters and Telegraph Transmission Equipment; Medium-frequency Induction Plants; Micalastic Insulation; Continuous Hopper - level Measurement; Intermodulation and Cross Modulation; Improved-safety Plug-and-socket Devices. The Siemens Review is published monthly by Siemens Aktiengesellschaft. Inquiries should be addressed to Siemens Industries Ltd., 544 Church Street, Richmond, Vic. 3121.

COMPONENTS REVIEW, Vol. 5, No. 4, August/September, 1968, describes the following: Resonant reed selectors; Tuning bar oscillator; Miniature relays; Hi-fi speaker kits; Pulse generator for digital ICs (application note); Integrated circuits DTL 930 series; 3 watt audio amplifier; Motor temperature control unit; Selenium rectifiers; Solid state HV rectifiers; Sidac light dimmer; Triacs; Photosensitive vacuum devices; Moulded rectifier assemblies. Components Review is published by Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W. 2170, to whom all inquiries should be addressed.

STANDARDS ASSOCIATION OF AUSTRALIA is seeking comment on a group of draft Australian standards for magnet winding wire, issued for public review in five parts as Docs. 1321, 1322, 1323, 1324 and 1325. The drafts cover general requirements (Doc. 1321), dimensions (Doc. 1322), test methods (Doc. 1323), test requirements (Doc. 1324), and packaging and labelling (Doc. 1325) of magnet winding wire used for windings of electrical equipment. The drafts at present apply only to round enamelled wire,

TRIO TR2E 2 Metre TRANSCEIVER

Features: Separate V.F.O. tuning for both receiver and transmitter; Nuvistor R.F. amplifier; Provision for crystal locking of transmitter; 12 volts D.C. (internal transistor P/S) and 230/240 volts A.C. operation; Noise limiter and squelch; 17 tubes, 4 transistors and 7 diodes; 1 microvolt sensitivity for 10 db S/N ratio at 146 Mcs; "S" meter, R.F. output meter and "netting" control.

Specifications: 1. Frequency Range: 144 to 148 Mcs. A.M. (146 Mcs. designed centre); 2. Transmit Input To Final: 25 watts; 3. Sensitivity: 1 Microvolt for 10 dB Signal to Noise Ratio at 146 Mcs. produces an output of at least 50 mw; 4. Image Ratio: 50 dB at 146 Mcs; 5. Noise Limiting: Automatic; 6. Squelch: 0-50 dB; 7. I.F. Frequencies: 1st 44-45 Mcs, 2nd 10.7 Mcs, 3rd 455 Kcs; 8. Selectivity: 30 dB Down at plus/minus 10 Kcs; 9. Audio Output: 3 Watts; 10. Antenna Impedance: 52 ohms (co-axial connector provided); 11. Power Supply: 230/240 V AC/12 V DC. 230/240 V AC, Receive Power Drain 106 VA AC. Transmit Power Drain 146 VA AC. 12 V DC, Receive Power Drain 90 VA DC, Transmit Power Drain 120 VA DC.

Price: $282.00.

VALVES

6J6 30c ea., 815 70c ea., 807 70c ea., 6AC7 20c ea. or 12 for $2, 6C4 50c ea., 1K7 20c ea., QS150/15 50c ea. VR150/30 75c ea. or 3 $2. 6AM6 50c ea., QB2/250 Philips (813). New in sealed cartons. Current manufacture, $7 ea.

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3.4-29.7 Mhz in 7 Bands. 455 Khz Mechanical Filter for SSB. 250W PEP, VOX, PTT, ALC. Internal Sidetone Osc. for CW. 30 Khz per turn Tuning Rate. Selectable USB/LSB. Break in Keying for CW (no relay chatter or clipped CW). SR 700A and ST 700 Combine for Transceive Operation while still maintaining separate Trans-Rec Facilities. ST700—$519.50.

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80 for $2.00 in Poly Packed Bags Mixed Values Only.

TRANSISTOR VHF CONVERTORS

Specification. 1. Frequency: 108 136 MC (Aircraft band.); 2. Battery: 9V transistor battery; 3. Antenna: Built-in telescopic antenna, 7-sections. 4. Dimensions: 1in x 2¾in x 4½in. 5. Weight: Approx.6,3oz.

Price: $14.40.

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Employs 4-807s in Parallel. Inbuilt 12v Genemotor. Ideal SSB Mobile Linear. Price, complete with Ant Tuning Unit and two spare 807s, $12. Due to weight (approx. 35lb), they will be sent freight forward.

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Contains Transistor, Resistor Capacitors, Diodes, etc. To build the following, 1. Audio Amplifier; 2. Sine Wave Oscillator; 3. Elastic Oscillator; 4. Theory of Electronic Organ; 5. Metronohm; 6. Water Level Alarm; 7. Morse Practice Oscillator; 8. Wireless Mike; 9. 2-Transistor Radio; 10. Short Wave Radio. No soldering necessary. In attractive Metal Case. Price: $14.95.

COMPLETE RANGE OF METERS

P25. 2¼in Sq. 100 uA, $5.75; 500 uA, $5.25; 10 mA, $5.00; 1 mA, $5.00; 50 mA, $5.00; S' Meter, $5.75; VU Meter, $6.50. MR3P 3⅜in Sq. 200 uA, $6.75; 500 uA, $6.50; 1 mA, $5.75; VR4P VU Meter, $8.15; MR4P 200 uA, $7.25.

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15	"	"	"	60	"	"	"
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TECHNICAL DETAILS:—

1. Frequency response 40-15 KC
2. Hum and noise level
3. Microphone better than 50 DB
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All ratings R.M.S. and provides for a tuner output voltage rise between Load and No Load less than 2 DB.

These amplifiers have been checked by the **R.M.I.T.** and passed for the **State Education Department,** also accepted by the **P.M.G.** Fully protected against shorted speaker lines.

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including enamel with a heat bonding layer.

Copies of Docs. 1321-1325 may be obtained, without charge, from the various offices of the Standards Association of Australia in all capital cities and Newcastle. Comment on the provisions of the drafts is invited from persons and organisations experienced in the manufacture or use of winding wire, and should reach the head office of the Association, 80 Arthur Street, North Sydney, N.S.W. 2060, or any branch office, not later than 31 December, 1968.

STANDARD COMPONENTS PTY. LTD., 10 Hill Street, Leichhardt, N.S.W. 2040, can supply copies of the following publications:

RCA Linear Integrated Circuits, Published 1967 by RCA Corporation, Harrison, N.J. 352 pages, price $3.00 tax paid.

RCA Silicon Power Circuits Manual. Published 1967 by RCA Corporation, Harrison, N.J., 415 pages, price $3.00 tax paid.

Radiotron Designers' Handbook, 4th Edition. Published by AWV Co. Pty. Ltd., edited by F. Langford Smith, price $7.50 tax paid.

RADIOTRONICS, Vol. 33, No. 3, August, 1968, includes the following articles: Wide-Band Amplifier and Discriminator Integrated Circuits; Circuit Factor Charts for Thyristor Applications; 3 Volt Regulated Power Supply; Understanding and Using the Dual-Gate MOSFET; News and New Releases; 2 Watt Complementary Output Audio Amplifier (part 2); Microphone Preamplifiers; Chopper Circuits Using MOS Field-Effect Transistors. Radiotronics is published quarterly by Amalgamated Wireless Valve Co. Pty. Ltd., and is available at a cost of 50c per copy from the Sales Department of the company at Private Mail Bag, Ermington, N.S.W. 2115.

HIGH FIDELITY LOUDSPEAKERS AND ENCLOSURES describes the use of loudspeakers and enclosures in modern hi-fi systems. Produced by the Rola Division of Plessey Components, it includes details of enclosures designed by the company for four of its range of loudspeakers. An application note describes the use of the 5FX tweeter and includes details of a crossover network and mounting. Copies of the pamphlet and Rola loudspeaker technical data are available from Rola distributors in all States or from the company's offices: The Boulevard, Richmond, Vic. 3121, or P.O. Box 2, Villawood, N.S.W. 2163.

TELECOMMUNICATION JOURNAL, Vol. 35, No. 10, October, 1968, contains an article by A. J. Higgs describing the Australian radioheliograph project. Other articles include "Power sources that can be used in telecommunications (Part 2)" by P. Guillot, "Fifty years of training in radio and telecommunication engineering in the USSR" by N. I. Chisyakov, and "Get to know the ITU — Philately — III, The Centenary (Part 2)" by J. Soulier.

In the "Ideas and Achievements" section, are published the draft text of the "Intersputnik" agreement; a short article on radio propagation experiments using the sun as a "satellite"; and an item on the installation of the first storage-programmed electronic telephone exchange in Belgium. Telecommunication Journal, published by the International Telecommunication Union, is in separate editions in English, French and Spanish. The subscription is 25 Swiss francs per language, single copies 2.50 Swiss francs. Inquiries to the Publication Service, International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland.

NEW TECHNOLOGY, No. 20 September, 1968, presents news of production, research and development from the British Ministry of Technology. It includes the following: Is bigger better?; FPRL aids furniture making; THE is the answer to exporters' technical problems; Mintech strengthens its service to process industries; Polymer chemistry advance gives cheaper printed circuits; News; Statistical indicators. New Technology is obtainable free from the Central Office of Information, Hercules Road, Westminster Bridge Road, London SE1, England.

SCIENTIFIC EQUIPMENT, No. 4, October, 1968, the new products guide produced by Watson Victor Ltd., includes the following:

Multitone paging system;
Hanovia photochemical reactor;
Qualtex incubator;
Hilger & Watts absorption spectrophotometer, and grating monochromator;
Revco ultra low temperature cabinets;
Anritsu counters, pulse generators, and frequency synthesizers;
Nikon profile projector;
Krautkramer thickness measuring instrument;
Toshiba tachometers;
Mettler analytical and precision balances;
Aminco-French pressure cell;
Goerz recorder;
Milton Roy minipumps.

All inquiries should be addressed to the company at 95-99 Epping Road, North Ryde, N.S.W. 2113.

ASSOCIATION INTERNATIONALE DE CYBERNETIQUE is publishing the proceedings of the 5th International Cybernetics Congress which was held in Namur, Belgium, from 11th to 15th September, 1967. Some 150 papers by scientists and research workers from 30 countries were read. The Proceedings of the 5th Congress will appear early in 1969, in the form of a volume of more than 1100 pages. Information concerning membership of the Association or its publications can be obtained from the Secretariat, Palais des Expositions, Place Andre Rijckmans, Namur, Belgium.

INDUSTRIAL RESEARCH NEWS, No. 71, September, 1968, includes the following items: Laboratory tests aid air pollution control; Engineering design analysis; Motorless refrigeration; Controlled fires. Industrial Research News is produced bi-monthly and is available free from the Industrial and Physical Sciences Branch, Commonwealth Scientific and Industrial Research Organisation, 314 Albert Street, East Melbourne, Vic. 3002.

ECCOBOND ADHESIVES is an updated reference chart which lists the important properties of the Eccobond line of adhesives offered by Emerson and Cuming Inc., Canton, Massachusetts, U.S.A. The illustrated chart is arranged to make the selection of an adhesive simple and rapid. Products with similar properties are grouped together with descriptions of the important mechanical, thermal and electrical properties in each group. A reference to the appropriate technical bulletin is also included. All inquiries should be addressed to the Australian agents, Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, 2208.

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1. 6-12 volt model auto test.
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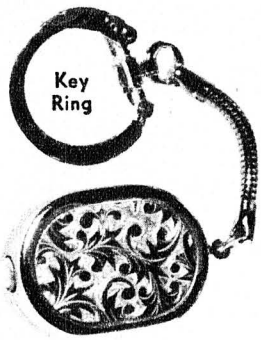

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With fob keyring, attractive gold finish case. Simply squeeze. Illuminates car and house locks, etc.

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Modern Design, 33 Micro-Amp Meter.
30,000 Ohms per Volt D.C.
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1 p.c. Multipliers and Shunts used.
Printed circuit.
Clear Scale, rugged moulded case.

SPECIFICATIONS:

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AC VOLTAGES: 0-2.5-10-25-100-250-500-1,000 V at 15,000 ohms per volt.
DC CURRENTS: 0.05-5-50-500 mA, 0-12 A.
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).
Decibels: Minus 20 to plus 56 dB (0 dB equals 1 mW, 600 Ohms).
Audio Out: Capacitor in series with AC Volt ranges.
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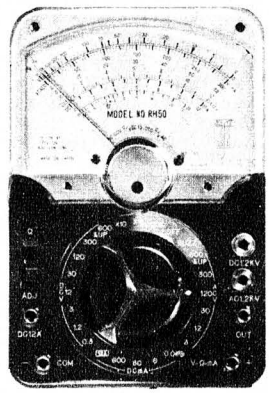

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Accessory: 1 pr. heavy test leads.
Batteries: 1 (1.5V), 1 (15V).
Size: 3 5/16" x 6 5/16" x 2¾".
Weight: 1.4lb approx.

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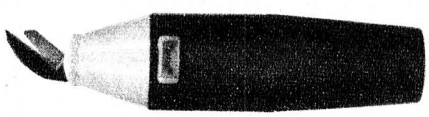

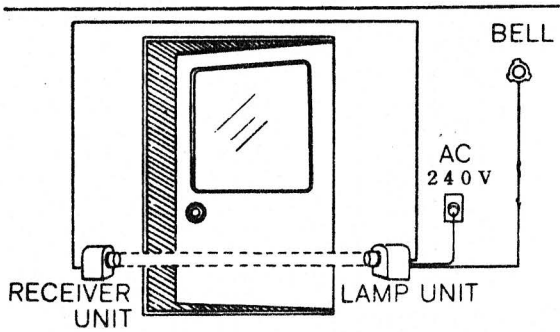

Photo-electric Alarm operates when beam of light across entrance, 20-50 ft., maximum, is broken by intruder. No wires or moving parts. This magic eye can be connected to a bell or light to announce the entrance of visitors, etc. 240 V. mains required.

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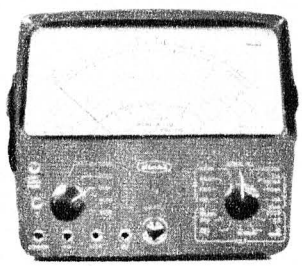
With Test Leads and Injector Probe



30,000 O.P.V.

SPECIFICATION: 6in x 2½in scale.
DC Voltage: 0-0.5, 2.5, 10, 50, 250, 500, 1,000 V at 30,000 o.p.v. 5,000 and 25,000 V at 10,000 o.p.v.
AC Voltage: 0-2.5, 10, 50, 250, 500, 1,000 V at 10,000 o.p.v.
Volume Level in Decibels.
DC Current: 0-50 uA, 1, 50, 250 mA, 0-1 and 10 amps.
AC Current: 0-1, and 10 amps.
Resistance: 0-10K, 100K, 1M, 100 Megohms. Signal Injector Output Jack. Zener Diode Overload Protection.

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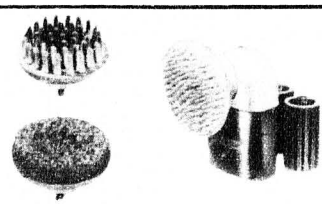
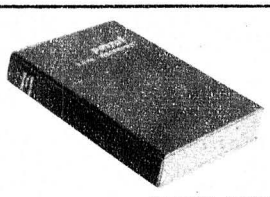
$8.50 or $9.00 posted.





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BOOK TYPE

The latest model portable Tape-recorder. 4 transistor, 3in Reels, 2 track. Instruction manual. Size 10½in x 7in x 1¼in.
Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price:

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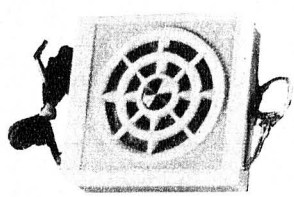


"CONION" transistorised **SIREN ALARM** can be used for personal protection or as a burglar alarm. Loud siren sounds for 20 minutes when cord is disturbed. Pocket size, easily concealed.

$11.75 complete. Posted, $12.00.

PORTABLE PLAYS 33 x 45 RECORDS

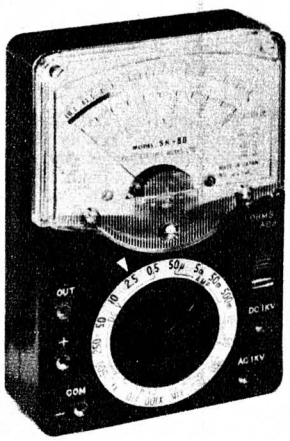
SIZE 9½" x 5½"

ALL TRANSISTOR RADIO
Phonograph. Complete
$45.00

NEW R H
(RADIO HOUSE) RANGE OF
MULTIMETERS

Features:
High sensitivity, minimizes the loading effect to the circuit under test.
Wide coverage of measuring ranges.
Clear, plastic dial covering for easy and accurate measuring

MODEL SK-80



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:
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AC Volts. 10, 50, 250, 500, 1000 V
DC Current: 50uA, 5mA, 50 mA, 500 mA
Resistance: 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ
Decibels. —10 + 62 lb
Accuracy. DC±3%, AC ±4% (of full scale)
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915
● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

$18.00 ***Postage 50c.***

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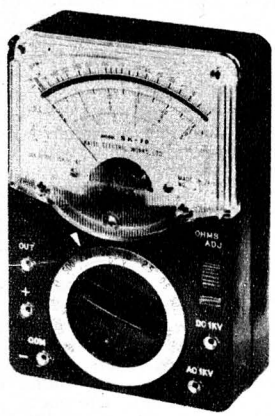

30,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000 V
AC Volts:. 10, 50, 250, 500, 1000 V
DC Current. 50 uA, 5 mA, 50 mA, 500mA
Resistance: 7 kΩ, 70 kΩ, 700 kΩ, 7 MegΩ
Decibels. —10 +62 db
Accuracy. DC±3%, AC± 4% (of full scale)
Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915
● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stablized film resistors.

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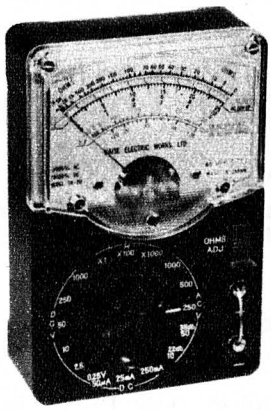

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*DC Current: 60 A, 12mA, 300mA.
*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.
*Decibels: -10 db +23 db.
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DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V
AC Volts. 10, 50, 250, 500, 1000 V
DC Current. 25 uA, 5 mA, 50 mA, 500 mA
Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ
Decibels. —10 +62 db
Accuracy: DC±3%, AC± 4% (of full scale)
Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915
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AMATEUR BAND NEWS AND NOTES

A Mobile Safari Through N.S.W.

The attendance at a Wireless Institute of Australia Zone Convention can afford the opportunity to combine amateur radio with the pleasures of a family holiday.

By Pierce Healy, VK2APQ*

Early in October the writer toured by car through southern New South Wales and spent a very enjoyable family holiday. Having mobile HF and VHF equipment installed added another dimension to the trip that can only be experienced through the friendship that exists between amateur radio operators.

The trip commenced as the annual safari to the South West Zone Convention of the N.S.W. division of the Wireless Institute of Australia, this year held at Griffith, the heart of the Murrumbidgee Irrigation Area, 420 miles south-west of Sydney. The return via the Snowy Mountains and Canberra made the total milage 1719.

These comments are an expression of thanks to the many contacts, both personal and on the air, that were made and to record some interesting observations on the use of the 146MHz FM net frequencies.

The mobile equipment was a SBE 34 four band SSB HF transceiver running 65 watts (PEP) to an 8 foot centre loaded whip antenna. Also, a converted Pye FM Ranger using channels A,B,C, (145.854MHz, 146.0MHz and 146.-146MHz) with a quarter wave whip antenna.

The main interest was the use of the VHF FM net frequencies, following the recent approval by the P.M.G. Department to allow unattended repeater installations by the amateur service; particular interest being in the experimental repeater installation operated by members of the Orange Radio Club at Mount Canobolas, near Orange.

Leaving Sydney early on Thursday 3rd October, the first contact was with Don VK2ALX on the FM net at Orange, when arrangements were made to check through the repeater while we were travelling to Dubbo. This was followed by a brief eyeball QSO with Bill VK2AWY and a visit to Channel 8 TV transmitter at Mount Canobalas and meeting Jim VK2ZWX. An unseasonal fall of 14 inches of snow two days before and pieces of ice falling from the tops of the TV towers added to the attraction of Mount Canobalas. A point of interest is that this 4500ft mountain is the highest point encountered, travelling west at that latitude, until reaching South Africa.

While travelling from Orange to Dubbo, a number of contacts were made through the repeater with Don VK2ALX at Orange, George VK2ZFG/M, Forbes, Bill VK2BT, Forbes, Bill VK2ACT/M, Dubbo. A get-together arranged by Cec VK2AKC resulted in a most enjoyable evening. Also there were Jim VK2AJO, Brian VK2AZW and Ken Page. The discussion included many aspects of amateur radio, the W.I.A. and plans for the Dubbo Amateur Radio Club. An eyeball QSO was also had with Tom VK2AMR before leaving Dubbo the next morning.

At Parkes, 7MHz contacts were made with Arie VK2AVA and Allan VK2ABA just after midday. Later in the evening contacts were made on 146MHz through the repeater with Carl VK2ZNK at Orange and VK2ZFG/M at Forbes, while a personal meeting took place with George VK2BGC and, later still, with some of the members of the Parkes District Amateur Radio Club, and their instructor Roland VK2ZVP.

During the afternoon another side of radio was seen when a visit was made to the C.S.I.R.O. Radio Telescope near Parkes and a tour of inspection of the installation was made. The 210ft diameter dish antenna dwarfs everything in the surrounding countryside and is a masterpiece of precision engineering. The focal point of the antenna is 90ft above the centre of the dish and when climbing along the walkways on the structure one is inclined to forget radio, and marvel at the engineering work involved, not only in the construction but also in the precision mechanism that allows the dish to be "locked" on a star or noise source so that it rotates and inclines, keeping the object in focus while the earth revolves on its axis.

But being a VHF operator at heart, some conjecture was made on the possibilities such an antenna would have for 144MHz, and higher, moonbounce experiments.

The work being carried out does not include any transmitting activity but is confined to the investigation of the source of radio frequency noise from various points in the heavens. While we were present, investigations were being made on signals emanating from the Hydrogen Line region of the Milky Way. These signals were being traced by pen recorders and processed by computer in the control room located in the concrete tower building that supports the huge dish antenna. It is worth noting that the work being carried out is well to the forefront of world-wide research of this type.

A visitors' centre is open to the public at the site. However, an inspection of the nature that we were privileged to make is only possible when arranged through C.S.I.R.O. officers in Sydney.

When leaving Parkes on Saturday morning for Griffith, a 'CQ' call through the repeater brought an unexpected reply from Tim VK2ZTM/M near Cowra on his way to Griffith. Peter VK2AXJ/M heading in the same direction was also contacted. Contact was also made with VK2BT, VK2ZKN and VK2ZFG via the repeater. All stations were outside direct VHF contact range.

Nearing Griffith, 7MHz contacts were made with VK3ARP and VK3ME, then 146MHz direct contact was made while still some miles from Griffith with Ted VK2AXD, base station for the convention, who guided us to the rendezvous at the C.W.A. Hall in Banna Avenue. Here I was honoured by the Convention organisers by being invited to officially open the Convention at the dinner that evening. A report on the Convention appears elsewhere in these notes.

Leaving Griffith on Monday morning for Cootamundra, contact was maintained with VK2AXD on 146MHz until reaching Leeton. After booking in at a motel in Cootamundra on Monday afternoon, it was decided to check the possibility of contact through the repeater at Orange from a point on the road about 10 miles from Harden, an airline distance in excess of 100 miles. This proved successful and contacts were made with VK2ALX, and VK2ZKN and VK2ZPC/M.

Tuesday morning saw us on the way to Tumut via Gundagai, the home of the immortal "Dog sitting on the Tucker Box." A stop was made at the ambulance station to say "hello" to Dave VK2DE. On arrival at Tumut, eyeball QSOs were had with Wal VK2AWC and Ross VK2PN and 146MHz contact with Keith

Season's Greetings to all readers of these notes

To those who have written expressing their interest in various aspects of amateur radio and those who have sent in notes on local and overseas events and other items of interest, a very sincere thank you.

Look forward to hearing from you again in 1969.

73'
VK2APQ

*** News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W., 2200.**

VK2ZAA. Leaving Tumut on Wednesday morning, a visit was made to the Blowering Dam and it was surprising to see the progress that had been made during the past 12 months. Several 146MHz checks were made with VK2ZAA between Tumut and Batlow.

The route from Tumut to Khancoban via Tumbarumba brought a complete change of country, from the flat plains of the irrigation area and wheat fields of the Riverina to the western side of the Snowy Mountains, where the snow-clad peaks marked the horizon. After passing through Tumbarumba, 146MHz contact was made with John VK2EZ, who directed us to the entrance to his property for a short chat. On taking our leave we were surprised to hear Treavor VK2ACZ whose property is some miles away across very hilly country. An unexpected pleasant three-way contact was maintained for some miles among the hills when some very surprising channelling effects on the VHF signals were experienced.

On arrival at Khancoban contact was made with Dennis VK2ZJZ who invited us to the Khancoban Radio Club meeting that evening, an invitation readily accepted. At the meeting we were introduced to members who followed a wide variety of occupations, most of whom are commencing their studies for the Amateur Operator's Certificate of Proficiency under the guidance of Jim Winkle and Dennis Johnstone, VK2ZJZ, for theory and Harry Pearson, the Morse code instructor. The evening concluded with an inspection of the Snowy Mountains Authority Radio Telephone installation. A 14MHz contact with VK0JW at Wilkes in Antarctica from the mobile demonstrated the value of single-sideband for DX contacts.

An inspection of the Murray 2 Switching Centre and the Murray 1 Power Station, arranged by Harry Pearson, added an unexpected facet to the trip for which we are grateful. The automatic control of the power generating and distribution installations, where megawatts is the normal term used, indicates to some degree the magnitude of the Snowy Mountains Scheme.

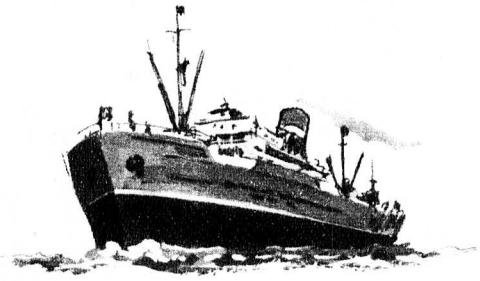
The trip to Jindabyne took us up through the snow country, with wonderful awe-inspiring scenery. An attempt was made to describe the view to Joe VK2JR and Jack VK2KQ/P at Lightning Ridge, on 7MHz during lunch at Scammels Lookout on the Alpine Way. Thredbo, the colourful alpine village was a point of considerable interest on the way and radio was forgotten for the beauty of the snow-covered mountains.

At the motel on the shore of the new Lake Jindabyne, 7MHz contacts were made with VK3SJ, Ben VK2BAI and Mac VK2ADV. A run to Perisher Valley as far as the road was open, and back, took us right into the snowfields. Then around through Adaminaby to Kiandra where 7MHz contact was made with Cec VK2AKC and George VK2GP who had received his full call since our 146MHz contact as VK2ZFG a few days previously. Then onto Cabramurra and return to Cooma for Friday night, a most exhilarating trip.

Before leaving for Canberra on Saturday morning, a call was made to Andy VK2WK to say "Hello" to an old acquaintance. Arrival at Canberra saw the renewal of the 146MHz net operation and during the overnight stay and departure on Sunday morning a large number of contacts were logged with VK1's ZWP, ZAV, ZMR, ZUM, AOP, VP, AU and CR from various locations around Canberra.

We were very pleased to meet again personally old friends in Ted VK1AOP, Eddie VK1VP and Reg VK1ZMR. Brief attempts were made to make contact through the repeater at Mount Canobalas from Black Mountain and Mount Majuras in the A.C.T. without success.

The trip back to Sydney was made via



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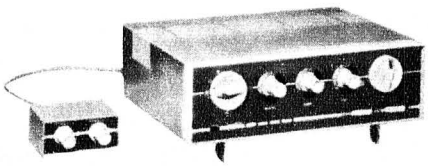

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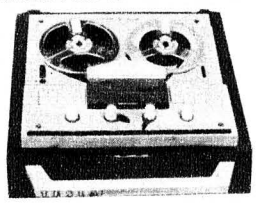

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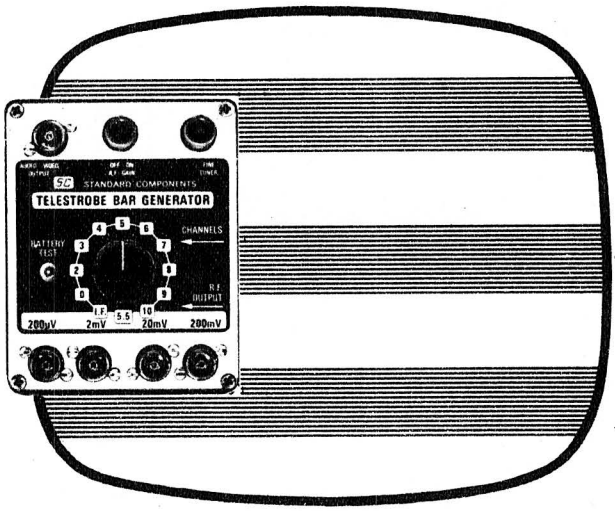

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Mount Gibraltar near Bowral, where a 146MHz channel B contact with Kevin VK2ANT was the last recorded for the trip.

To sum up, here are some observations made during the trip:

Despite the "appliance operator" tag applied to 146MHz net operators, this method of communication does have its place in amateur radio. It should not, however, be used for home station operation to the exclusion of general coverage 144MHz equipment.

With the growth of repeater installations the range and use of VHF as an intrastate means of communication will increase and become a real asset to the community in the event of emergencies due to fires or floods. Muted receivers can be left in operation to come alive immediately a call is made from another station.

Motel accommodation throughout the trip was good, as were the roads. But it was noted that the bumpiest 50 mile continuous stretch was the Federal Highway from Canberra to Goulburn.

The remark has been made that we do not know what pleasant surprises await us on these safaris. This one was no exception, due to the friendship found among amateur radio operators.

If the use of the word "we" is not clear, suffice to say it was used to include Leon, my son-in-law, who is studying for the A.O.C.P. (Who said, "What! Another one in the family"? That was a light-hearted comment (we hope) from the wives in the party.) But they are already looking forward to the convention at Albury in 1969.

VALE

It was with deep regret that the news of the death of Bill Clark on October 20th was received by council and members of the New South Wales Division of the W.I.A.

Bill had for more than 12 years given his professional services as Honorary Legal Adviser to the N.S.W. Division. Although not a licensed operator, he had a very keen interest in amateur radio and the wellbeing of the institute.

Many calls were made on him over the years to give guidance on matters relating to the revision of the division's constitution and more recently on the problems associated with agreement to the new Federal Constitution of the Institute.

His many friends express their deep sympathy to his wife and family.

W.I.A. ACTIVITIES

The proposed International Telecommunication Union Conference to be held late 1970 or early 1971, known as the World Administrative Space Conference, could affect amateur service frequency allocations. This cannot be finally assessed until the agenda is issued, possibly during the latter half of 1969. Federal Executive of the W.I.A. and Divisional Councils urge all members who have not yet done so, to contribute to the Institute I.T.U. Fund.

NEW SOUTH WALES

Due to pressure of business, Keith Finney, VK2KJ, has resigned as President of the N.S.W. Division and member of Council. Keith had held office for 18 months, and members of Council and members of the Division expressed their sincere thanks for the work he had done for the Institute during this period. Don Miller, VK2GW, has been elected to the position of President. Gordon Clarke, VK2ZXD, has been co-opted to fill the vacancy on Council.

From October 14th-20th, VK2AWI, the official station of the N.S.W. Division, was in operation from the Roselands Shopping Centre. The display created quite some interest among the visitors to the centre and many inquiries were made regarding amateur radio and the W.I.A.

The display was organised by Gordon Clarke, VK2ZXD, and was assisted by a number of operators. A Galaxy SSB transceiver and vertical antenna was lent by Arie Bles, VK2AVA, and many excellent reports were received from DX stations. The station also participated in the Boy Scout Jamboree-of-the-Air.

South West Zone Convention:

The annual convention of the South West Zone Convention of the N.S.W. Division was held over the weekend October 5th and 6th. The venue was Griffith in the heart of the Murrumbidgee Irrigation Area. Following registration of visitors on Saturday at the C.W.A. Hall, Banna Avenue, a conducted tour was made of the C.S.I.R.O. Research Centre of the M.I.A. Agronomists attached to the Centre explained the work being carried out with various types of crop control, of pests and soil deficiencies as affecting plant growth.

The official dinner was attended by 73 members, visitors and their families. After welcoming guests on behalf of the Convention organising committee, Ted Druitt, VK2AXD, invited Pierce Healy, VK2APQ, Federal Councillor of the N.S.W. Division, W.I.A., to officially open the Convention. In expressing his pleasure at the honour bestowed on him Pierce reviewed briefly some aspects associated with the well-being of the amateur service.

Tim Mills, VK2ZTM, Councillor of the N.S.W. Division, spoke on divisional activities and work being done in regard to repeater/translator installations and proposed frequencies.

Harry Cuthbert, VK2AEC, South West Zone Officer spoke on the Zone activities and the future of amateur radio.

After dinner, colour slides were screened and two 144MHz Fox hunts were held. On Sunday morning an inspection of Penfolds Winery was made and the local product sampled. This was followed by a

(Continued on Page 157)

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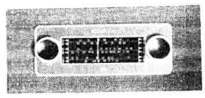

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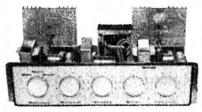

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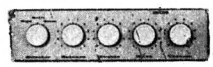

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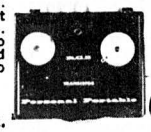

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MC-7 Crystal, 100-7K. 39mm Round x 11 mm. -56 DB . . . . . $1.00 ea.
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MC-9 Crystal, 50-8K, 25mm Round x 9mm. -68 DB . . . . . $1.80 ea.
MC-33 Crystal, 50-10K, 33mm Round x 9m -60 DB . . . . . $1.30 ea.
MD-5 Dynamic, 100-15K. 33mm Round x 14mm. -55 DB . . . . . $1.80 ea.
Plus postage 20c.

TRANSISTOR SET ACCESSORIES

Magnetic Earpiece with 3.5mm Plug . . 75c
Crystal Earpiece with 2.5mm Plug . . . 75c
Crystal Earpiece with 3.5mm Plug . . . 75c
Crystal Earphone, less plusg . . . . . 20c ea.

LAPEL TYPE CRYSTAL MICROPHONE

With 3.5mm Plug . . . . . $1.00 ea.
Plus postage 15c.
Fuses for Japanese equipment 1A, 3A, 5A 3c ea, OR $2.00 per 100. Plus postage 10c.

EDYSTONE TYPE CERAMIC INSULATED TUNING CAPACITORS

15 PF, 50 PF, 100 PF.
$2.40 ea. Plus postage 20c.

TELETRON 7-PIN SHORT VALVES CANS

10c ea. Plus postage 10c.

ROBLAN TUNING CAPACITORS

All types carried in stock.
Priced from $1.90 ea. Plus postage 20c.

PRINTED CIRCUIT TYPE UN-SHIELDED 9-PIN SOCKETS

10c ea. Plus postage 10c.

12-Pin Wafer Sockets. . . . . 20c ea.
12-Pin Plugs . 25 ea. Plus postage 10c.

OCTAL PLUG AND CORD

Ext. Socket.
45c pr. Plus postage 10c.

ALL TYPES AMPHENOL PLUGS AND SOCKETS

Carried in stock.
Plugs 27c ea. Sockets 30c ea. Meall Covers for same 27c ea.
Plus postage 10c.

HALF-INCH MINIATURE PLUGS AND SOCKETS

2, 3, 4 and 5-Pin Plugs 10c ea.
Sockets 10c ea. Plus postage 10c.

ELECTROLYTIC CAPACITORS IN METAL CANS

16 + 16 450 VW . . . . . 95c ea.
32 + 32 450 VW . . . . . $1.30 ea.
50 + 50 450 VW . . . . . $1.85 ea.
50 + 50 + 50 350 VW . . . . . $1.90 ea.
100 MFD P.V.C. Cover . . . . . $1.15 ea.
Jacks, 2.5 and 3.5mm 20c
3.5mm Plug and Cord Ext. Jack Pair . . 50c
Metal Co-axial Plugs and Line Sockets Pr. 65c
"Din" and "Hirschmann," 2, 3, 4 and 5-pin Plugs, Chassis and Line Sockets, carried ex stock.
Prices on application.
P.M.G. type Plugs from 50c
P.M.G. type Jacks from 35c
P.M.G. Line Jacks from 55c
Plus postage 15c.

Capacitor Substituion Box, 1,000 VW . . $5.00
Resistor Substitution Box, 1 Watt. Plus Post, 20c. $4.50

TRANSISTOR AERIALS

4in extends to 27in $1.60
5in extends to 39in $1.70
6in extends to 43in $1.40
6in extends to 32in $1.00
6in extends to 28in $1.00
7in extends to 39in $1.20
9in extends to 39in 95c
6in extends to 4ft 6in $1.80
7in extends to 5ft 8in $2.10
Plus Post 15c.

CRYSTAL SET BUILDERS

Coils 80c
Diodes 35c
Headphones . . . $2.50
Tuning Conds. . $2.00
Terms . . Ea. 12c
Plus Postage.

TAPE RECORDER ACCESSORIES

2½in Spools . . 30c
3in Spools . . 35c
5in Spools . . 40c
5¾in Spools . . 70c
7in Spools . . . 50c
2½in x 100ft Tape 60c
2½in x 300ft Tape . . . $1.40
3in x 600ft Tape $2.35
5¾in x 1,200ft Tape $3.10
7in x 1,800ft Tape $5.10
5in Plastic Tape, boxes 60c
7in Plastic Tape, boxes 90c
Plus postage 20c.

See us for Tape Recorder Patch Cords, Adaptors, etc.

NIBBLING TOOL CUTTERS

$3.50 ea. Plus postage 20c.

STEREO PLUGS AND JACKS

Metal Plugs . . 95c
Bakelite 70c
Metal ext. sockets . . . 95c
Bakelite ext. sockets . . . 70c
Chassis Jacks . 65c
Plus postage 10c.

MAIL ORDER SPECIALISTS

1968 REMEMBRANCE DAY CONTEST RESULTS

The 1968 Remembrance Day Contest held last August was won by Tasmania with a total score of 5,367 points. This is the highest state score since 1964 when South Australia won with 5,707 points. The win was well deserved as the results showed that Tasmania had the highest percentage of stations participating and the average of the top six logs submitted was the highest ever recorded in the contest.

In the report on the contest, Neil Penfold, Federal Contest manager of the Wireless Institute of Australia, recorded that band conditions were most favourable, with many logs showing numerous 28MHz contacts. Also, that the use of single-sideband was noticeably predominant and because of this there was less interference between stations, despite the large pile-ups that occurred.

The report also contained an analysis of the last eight years' top individual station scores. This showed that the 1968 contest produced the highest scores with the top logs from all states being over 1200 points. The highest individual score was 1822 points by VK7DK, a record for the contest.

AWARD WINNERS

New South Wales

Phone:

J. R. Watt-Bright	VK2YN	1101 pts.
R. C. Norman	VK2ZCF	69 pts.
C. W.:		
T. F. Evans	VK2NS	566 pts.
Open:		
E. L. Andrews	VK2BO	1227 pts.

Victoria

Phone:

K. J. Hartigan	VK3VK	1251 pts.
R. J. Jennings	VK3ZUE	24 pts.
C.W.:		
P. J. Dettman	VK3APJ	658 pts.
Open:		
J. F. Ryan	VK3ASW/P	1083 pts.

Queensland

Phone:

N. B. Walden	VK4WW	1129 pts.
R. J. Hoare	VK4ZHO	20 pts.
H. L. Wickes	VK4ZHW	20 pts.
C.W.:		
G. Harmer	VK4XW	367 pts.
Open:		
A. L. Hoey	VK4RH	1398 pts.

South Australia

Phone:

H. E. Vivian	VK5FO	1350 pts.
R. E. Burns	VK5ZNH	60 pts.
C.W.:		
W. E. Catchpoole	VK5AU	251 pts.
Open:		
N. G. Wallage	VK5GW	1238 pts.

Western Australia

Phone:

I. Kauler	VK6XX	1419 pts.
W. E. Olson	VK6ZBB	30 pts.
C.W.:		
D. Couch	VK6WT	463 pts.
Open:		
J. E. Rumble	VK6RU	1651 pts.

Tasmania

Phone:

W. J. Henry	VK7WH	1673 pts.
G. C. Johnston	VK7ZKJ	38 pts.
C.W.:		
	VK7ZL	310 pts.
Open :		
D. H. Kelly	VK7DK	1822 pts.

Other Call Areas

Phone:

J. E. George	VK1JG	698 pts.
B. J. Burns	VK8DI	606 pts.
W. Dalgleish	VK9WD	1001 pts.
A. Nickols	VK0AL	106 pts.
C.W.:		
H. G. A. Anderson	VK8HA	276 pts.
Open:		
D. A. McArthur	VK8KK	1147 pts.
G. F. Pooley	VK9DJ	1121 pts.

Listeners' Section

N.S.W.:	P. Girdo	1413 pts.
Vic.:	R. Trenayne	1215 pts.
S. Aust.:	S. Ruediger	1345 pts.
Q'land:	K. D. Cunningham	564 pts.
W. Aust.:	P. W. Drew	1600 pts.
Tas.:	B. Livingston	1076 pts.
Papua:	R. Stewart	376 pts.

Analysis

Top Six Logs for 1968:

VK2BO	1227 points	399 contacts
VK3VK	1251 points	427 contacts
VK4RH	1498 points	463 contacts
VK5FO	1350 points	497 contacts
VK6RU	1651 points	605 contacts
VK7DK	1822 points	606 contacts

State Scores:

Tasmania	5367 points
Western Australia	4795 points
South Australia	3373 points
Queensland	2771 points
New South Wales	1998 points
Victoria	1771 points

Details of State Scores

State	Logs Entered	Licences	Percentage Participation	Average Top Six Logs	Total State Points	State Score
N.S.W.	72	1744	4.1	1114	21,407	1998
Vic.	60	1702	3.5	1041	20,689	1771
Q'land	60	661	9.0	1102	18,546	2771
S. Aust.	85	720	11.8	1132	19,251	3373
W. Aust.	83	424	19.6	1115	18,809	4795
Tas.	65	217	30.0	1294	13,577	5367

WARBURTON FRANKI

XMAS BARGAINS

SPECIAL CONDENSER POLYPAC No. 20

Contains 25 assorted condensers, including ceramic, electrolytic, metal pack, mica, paper tubular. **$1 plus postage, 10c (or five for $5, post free).**

CERAMIC CONDENSER POLYPAC No. 21

25 assorted ceramic condensers—**$1 plus 10c pack and post (or five for $5 post free).**

ELECTROLYTIC CONDENSER POLYPAC No. 22

12 assorted miniature electrolytic condensers—**$1 plus 10c pack and post (or five for $5 post free).**

RESISTOR POLYPAC No. 23

50 assorted ½-watt resistors—**$1 plus 10c pack and post (or five for $5 post free).**

Above Polypacs may be assorted to get concession price of 5 for $5 post free.

RESISTOR POLYPAC No. 24

20 Hi-stability 1-watt, ± 1% resistors—**$3.50 plus 10c pack and post.**

Values may be specified, but if not in stock nearest will be supplied.

DUCON BLOCK CONDENSERS

20 mfd. 400 V.D.C.W. 250 V.A.C.W. Unused and complete with mounting brackets—**$4.95 post free.**

CRYSTAL LAPEL MICROPHONES

Complete with Cord and Plug—**$1.75 post free.**

POWER SUPPLY BASIC KIT

Consists of:

One Transformer tapped for 9v and 12v at 500 ma.

One full-wave contact-cooled rectifier.

One 1,000 mfd 15 V.W. capacitor.

Make your own 9 or 12-volt power pack to supply transistor radios, record-players, slot cars, toys, etc.

Supplied with wiring diagrams—**$3.85 post free.**

PICO SOLDERING IRON KITS

Handyman's or hobby kit. Includes straight and angle bits, small file, screwdriver, rubbing down brush, resin core solder—**$7.95 post free.**

TELECALL—MINI DOOR-PHONE

2 MODELS:

1. **WITH FLUSH MOUNT SLAVE UNIT (Stainless Steel).**
2. **WITH SURFACE MOUNT SLAVE UNIT. (Plastic).**

Normally used to communicate with visitors at front or rear door from kitchen, etc., or may be used as a high-quality intercom., between any two locations. **Supplied complete with battery and 50ft wire.**

Either set. $11.95 Post free.

Surface Mount Type

Flush Type

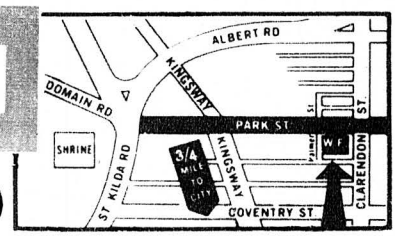
807 VALVES

AMERICAN SYLVANIA **$1.75 each, including postage.**

Packs of 10, inc. postage $15.50

WARBURTON FRANKI

220 PARK ST., STH. MELB., VIC. Ph. 69-0151 (30 lines)



ROSS HULL MEMORIAL CONTEST

The Federal Contest Committee of the Wireless Institute of Australia invites all Australian and overseas amateur operators and shortwave listeners to participate in the 1968-1969 Ross Hull Memorial VHF/UHF Contest which is held annually to perpetuate the memory of Ross Hull whose interest in VHF/UHF did much to advance the art.

A Perpetual Trophy is awarded annually for competition between members of the Wireless Institute of Australia in Australia and its Territories, inscribed with the name and life work of the man whom it honours. The name of the winning member of the W.I.A. each year is also inscribed on the Trophy. In addition the member will receive a suitably inscribed certificate.

OBJECTS:

Australian amateur operators will endeavour to contact as many other amateurs in Australia and overseas under the following conditions.

Date of Contest:

From 0001 hours Eastern Australian Time, December 7th, 1968 to 2359 hours Eastern Australian Time, January 12th, 1969.

Duration:

Any seven calendar days within the dates mentioned above, not necessarily consecutive. These periods are to be at the convenience of the operator. A calendar day is from 0001 hours E.A.T. to 2359 E.A.T.

Rules:

1. There are two divisions, one of 48 hours duration, and one for seven days. In the seven-day division, there are three sections:—

(a) Transmitting, Open;

(b) Transmitting, Phone;

(c) Receiving, Open.

2. All Australian and overseas amateurs may enter the contest whether their stations are fixed, portable or mobile.

3. All amateur VHF/UHF bands may be used, but no cross-band operation is permitted. Operators are cautioned against operating transmitting equipment on more than one frequency at a time, particularly when passing cyphers. Cross-band operation to assist contest working is prohibited.

Such operation will be grounds for disqualification. Cross mode contacts will be permitted.

4. Amateurs may enter for any of the transmitting sections. The seven-day section winner is not eligible for the 48-hour award.

5. Only one contact per band per station is allowed each calendar day.

6. Only one licensed amateur is permitted to operate any one station under the owner's call sign. Should two or more operate any particular station, each will be considered a contestant and must submit a separate log under his own call sign.

7. Entrants must operate within the terms of their licences.

8. Cyphers: Before points may be claimed for a contact, serial numbers must be exchanged. The serial numbers of five or six figures will be made up of the RS (telephony) or RST (C.W.) report plus three figures commencing in the range 001 to 999, for the first contact, and will then increase in value by one for each successive contact. When a contestant reaches 999 he will then commence again with 001.

9. Entries must be set out as shown in the example, using only one side of the paper. Entries must be postmarked not later than February 10th, 1969, and clearly marked "Ross Hull Contest" and addressed to: Federal Contest Manager, Box N1002, G.P.O., Perth, W.A. 6001.

10. Scoring for all sections will be based on the attached table. Distances must be shown in the log entry as shown in the example. Failure to make this entry will invalidate the particular claim. Some typical distances are given in the attached table.

11. Logs: All logs shall be set out as in the example and in addition will carry a summary sheet showing the following information:

Name ..... Call sign .....

Address ..... Division .....

..... Claimed Score .....

Operating Dates ..... (7 calendar days)

Highest score over a 48-hour period was .... points.

Operating period:

From ..... hrs. E.A.T. ../..../..6..

To ..... hrs. E.A.T. ../..../..6..

Declaration: I hereby certify that I have operated in accordance with the conditions of my licence and abided by the rules of the contest.

Signed .....

date .....

12. Entrants not abiding by the rules of this contest will be disqualified.

13. The ruling of the Federal Contest Committee of the W.I.A. will be final. No dispute will be entered into.

14. Awards: Certificates will be awarded to the winners of each section in each VK and overseas call area. The VK contestant who returns the highest score in the transmitting section and who is a financial member of the W.I.A., will have his name inscribed on the trophy which will be held by his division for the prescribed period. A certificate will be awarded to the contestant who shall not be the trophy winner, and who returns the highest scoring log covering a period of any consecutive 48 hours.

Also, certificates will be awarded for operating in the Ross Hull Contest and breaking any Australian VHF/UHF distance record.

Receiving Section:

1. Short-Wave Listeners in Australia and overseas may enter for the contest, but no transmitting station may enter.

2. Contest times and logging of stations on each band are as for the transmitting sections. However, there is no 48-hour sub-section.

3. To count for points, logs will take the same form as for transmitting sections, but will omit the serial number received. Logs must show the call sign of the station heard (not the station worked), the serial number sent by it, and the call sign of the station being worked.

Scoring will be on the same basis as for transmitting stations, i.e. on the distance between the listener's station and the station heard. See examples given. It is not sufficient to log a station calling "CQ."

4. A station heard may be logged only once per calendar day on each band for scoring purposes.

5. Awards: Certificates will be awarded to the highest scorer in VK and overseas countries.

EXAMPLE OF TRANSMITTING LOG (Brisbane Station)

Date/Time E.A.T.	Band MHz	Power Emission	Call Sign	RST/No Sent	RST/No Rec'd	Dist. Miles	Points Claimed
24th Dec. 0110	52	A3(a), 50W.	VK7ZAI	59001	59004	1110	10
0110	52	A3(a), 50W.	VK4NG	58002	57051	330	10
0230	144	A3, 150W.	VK5ZK	56003	55043	990	25
0235	144	A3, 150W.	VK3ZJQ	45004	46021	850	25

EXAMPLE OF RECEIVING LOG (Perth S.W.L.)

Date/Time E.A.T.	Band MHz	Call Heard	RST/No Sent	Station Called	Dist. Miles	Points Claimed
2nd Jan. 1000	52	VK5ZDX	59221	VK8KK	1330	10
1025	52	VK2ZCF	58195	VK6ZAA	2040	20
1110	432	VK6ZDS/6	57061	VK6LK/6	60	25
3rd Jan. 0500	144	VH5ZHJ	44102	VK6ZCN	1330	50

SCORING TABLE

Distance in miles	52MHz	144MHz	432MHz	576MHz	Higher
Up to 25 miles	1	1	2	2	20
26 to 50 miles	1	1	10	10	50
51 to 100 miles	2	5	25	30	100
101 to 200 miles	5	10	50	60	200
201 to 300 miles	15	15	75	85	250
301 to 500 miles	10	20	100	125	300
501 to 1050 miles	5	25	200	200	350
1051 to 1500 miles	10	50	250	250	400
1501 to 2500 miles	20	100	300	300	450
2501 to 3500 miles	35	200	400	400	500
3501 to 5000 miles	50	300	450	450	550
5001 and over	100	400	500	500	600

DISTANCE TABLE

	SYDNEY	CANBERRA	BRISBANE	MELBOURNE	HOBART	ADELAIDE	N. ZEAL.	DARWIN	Perth
SYDNEY	0	160	460	450	660	710	1300-1500	1950	2040
CANBERRA	160	0	600	290	530	670	1300-1500	1930	1940
BRISBANE	460	600	0	860	1110	990	1500-1700	1790	2240
MELBOURNE	450	290	860	0	400	400	1500-1700	1930	1720
HOBART	660	530	1110	400	0	710	1300-1500	2280	1880
ADELAIDE	710	670	990	400	710	0	1900-2100	1620	1330
NEW ZEALAND	1300-1500	1300-1500	1500-1700	1500-1700	1300-1500	1900-2100	0	2550	3000-3200
DARWIN	1950	1930	1790	1930	2280	1620	2550	0	1650
PERTH	2040	1940	2240	1720	1880	1330	3000-3200	1650	0

W.I.A. LIST OF COUNTRIES

The current alphabetical list of prefixes issued by the Wireless Institute of Australia for the purpoes of "DX Awards" is given below. Australian DX Century Club Awards are issued by the Wireless Institute of Australia in accordance with this list.

Prefix	Country
AC3	Sikkim
AC4	Tibet
AC5	Bhutan
AP	East Pakistan
AP	West Pakistan
BV (C3)	Formosa
BY (C)	China
CE	Chile
CE9, KC4,	Antarctica
LU-Z, VK0,	Antarctica
VP8, ZL5 etc.	Antarctica
CE0A	Easter Island
CE0X	Felix Island
CE0Z	Juan Fernandez Arch.
CM, CO	Cuba
CN2, 8, 9	Morocco
CP	Bolivia
CR3	Portuguese Guinea
CR4	Cape Verde Islands
CR5	Principe, Sao Thome
CR6	Angola
CR7	Mozambique
CR8, 10	Portuguese Timor
CR9	Macao
CT1	Portugal
CT2	Azores
CT3	Madeira Islands
CX	Uruguay
DJ, DL, DM	Germany
DU	Philippine Islands
EA	Spain
EA6	Balearic Islands
EA8	Canary Islands
EA9	Ifni
EA9	Rio de Oro
EA9	Spanish Morocco
EA0	Spanish Guinea
EI	Republic of Ireland
EL	Liberia
EP, EQ	Iran
ET2, 3, 9E	Ethiopia
F	France
FB8	Amsterdam and St. Paul Islands
FB8	Crozet Island
FB8	Kerguelen Island
FC	Corsica
FG7	Guadeloupe
FH8	Comoro Islands
FK8	New Caledonia
FL8	French Somaliland
FM7	Martinique
FO8	Clipperton Island
FO8	French Oceania
FO8	Maria Theresa
FP8	St. Pierre and Miquelon Islands
FR7 (from 25/6/60)	Glorioso Island
FR7	Juan Nova and Europa Islands
FR7	Reunion Island
FR7	Tromelin Islands
FS7	Saint Martin
FU8, YJ1, 8	New Hebrides
FW8	Wallis and Futuna Islands
FY7	French Guinea and Inini
G	England
GC	Guernsey and Dependents
GC	Jersey Island
GD	Isle of Man
GI	Northern Ireland
GM	Scotland
GW	Wales
HA	Hungary
HB	Switzerland
HBO (HE)	Liechtenstein
HC	Ecuador
HC8G	Galapagos Islands
HH	Haiti
HI	Dominican Republic
HK, 5J	Colombia
HKO	Arch. of San Andres and Providencia
HKO	Bajo Nuevo
HKO	Malpelo Islands
HL, HM	Korea
HP	Panama
HR	Honduras
HS	Thailand
HV	Vatican
I1, IT1	Italy
IS1	Sardinia
JA, KA	Japan
JT1	Mongolia
JY	Jordan
K, W	U.S.A.
KAO, KG61	Bonin and Volcano Islands
KB6	Baker, Howland and American Phoenix Islands, including Canton Island
KC4	Navassa Island
KC6	Eastern Caroline Islands
KC6	Western Caroline Islands
KG4	Guantanamo Bay
KG6	Guam
KG6	Marcus Island
KG6	(Rota, Tinian, Saipan, etc.) Mariana Islands
KH6	Hawaiian Islands
KH6	Kure Island
KJ6	Johnston Island
KL7	Alaska
KM6	Midway Island
KP4	Puerto Rico
KP6	Palmyra Group, Jarvis Island
KR6	Ryukyu Islands
KS4B	Serrana Bank and Roncador Cay
KS4	Swan Island
KS6	American Samoa
KV4	Virgin Islands
KW6	Wake Island
KX6	Marshall Islands
KZ5	Canal Zone
LA	Bouvet Island
LA, JX	Jan Mayen
LA	Norway
LA, JW	Svalbard
LU	Argentina
LX	Luxembourg
LZ	Bulgaria
MP4B	Bahrein
MP4Q	Qatar
MP4D, T	Trucial Oman
OA	Peru
OD5	Lebanon
OE	Austria
OH	Finland
OH0	Aland Islands
OK	Czechoslovakia
ON4	Belgium
OX, KG1, XP	Greenland
OY	Faeroes
OZ	Denmark
PA0, PI1	Netherlands
PJ	Netherlands West Indies
PJ2M	Sint Maarten
PX	Andorra
PY	Brazil
PY0	Fernando Noronha
PY0	St. Peter and Paul Rocks
PY0	Trindade and Martin Vaz Islands
PZ1	Netherlands Guiana
SL, SM	Sweden
SP	Poland
ST2	Sudan
SU	Egypt
SV	Crete
SV	Dodecanese
SV	Greece
TA	Turkey
TF	Iceland
TG	Guatemala
TI	Costa Rica
TI9	Cocos Island
TJ (FE8)	Cameroon Republic
TL8, (from 13/8/60)	Central African Republic
TN8, (from 15/8/60)	Congo Republic
TR8, (from 17/8/60)	Gabon Republic
TS (3V8)	Tunisia
TT8, (from 11/8/60)	Chad Republic
TU2, (from 7/8/60)	Ivory Coast Republic
TY2, (from 1/8/60)	Dahomey Republic
TZ2, (from 20/6/60)	Mali Republic
UA, UV	European R.S.F.S.R.
UW1-6, UN1	European R.S.F.S.R.
UA1	Franz Josef Land
UA2	Kaliningrad Region
UA, UW9, 0	Asiatic R.S.F.S.R.
UB5, UY5,	Ukraine
UT5	Ukraine
UC2	White Russian S.S.R.
UD6	Azerbaijan
UF6	Georgia
UG6	Armenia
UH8	Turkoman
UI8	Uzbek
UJ8	Tadzhik
UL7	Kazakh
UM8	Kirghiz
UO5	Moldavia
UP2	Lithuania
UQ2	Latvia
UR2	Estonia
VE, VO	Canada
VK	Australia
VK2	Lord Howe Island
VK4	Willis Island
VK9	Christmas Island
VK9, ZC3	Cocos Island
VK9	Nauru Island
VK9	Norfolk Island
VK9	Papua Territories
VK9	Territory of New Guinea
VK0	Heard Island
VK0	Macquarie Island
VP1	British Honduras
VP2	Anguilla
VP2	Antigua, Barbuda
VP2	British Virgin Islands
VP2	Dominica
VP2	Grenada and Dependents
VP2	Montserrat
VP2	St. Kitts, Nevis
VP2	St. Lucia
VP2	St. Vincent and Dependents
VP3 (See 8R)	
VP5	Turks and Caicos Islands
VP6	Barbados
VP7	Bahama Islands
VP8	Falkland Islands
VP8, LU-Z	South Georgia
VP8, LU-Z	South Orkney Islands
VP8, LU-Z	South Sandwich Islands
VP8, LU-Z,	South Shetland Islands
CE9	South Shetland Islands
VP9	Bermuda Islands
VQ8	Agalegla and St. Brandon
VQ8	Chagos Islands
VQ8	Mauritius
VQ8	Rodriguez Island
VQ9	Aldabra Islands
VQ9D, (from 10/11/65)	Desroches
VQ9F, (from 10/11/65)	Farquhar Islands
VQ9	Sechelles
VR1	British Phoenix Islands (including Canton Island)
VR1	Gilbert and Ellice Islands Ocean Islands
VR2	Fiji Islands
VR3	Fanning and Christmas Islands
VR4	Solomon Islands
VR5	Tonga Islands
VR6	Pitcairn Island
VS5	Brunei
VS6	Hong Kong
VS0A, P, S	Aden and Socotra
VS9H	Kuria Muria
VS9K	Kamaran Islands
VS9M	Maldive Islands
VS9O, MP4M	Sultanate of Oman
VU2	India
VU	Laccadive Islands

FOR D.X.C.C. AWARDS

VU	Andaman and Nicobar Islands
XE, XF	Mexico
XF4	Revilla Gigedo
XT2, (from 5/8/60)	Voltaic Republic
XU	Cambodia
XW8	Laos
XZ2	Burma
YA	Afghanistan
YI	Iraq
YK	Syria
YN, YNO	Nicaragua
YO	Romania
YS	Salvador
YU	Yugoslavia
YV	Venezuela
YVO	Aves Island
ZA	Albania
ZB2	Gibraltar
ZC6	Palestine
ZD3	The Gambia
ZD5 (ZS7)	Swaziland
ZD7	St. Helena
ZD8	Ascension Islands
ZD9	Tristan da Cunha and Gough Islands
ZE	Southern Rhodesia
ZF(V)P5	Cayman Islands
ZK1	Cook Islands
ZK1	Manihiki Islands
ZK2	Niue
ZL	Chatham Islands
ZL	New Zealand
ZL1	Kermadec Islands
ZL4	Auckland and Campbell Islands
ZM7	Tokelaus
ZP	Paraguay
ZS1, 2, 4, 5, 6	Republic of South Africa
ZS2	Prince Edward and Marion Island
ZS3	South-West Africa
ZS8	Lesotho (Basutoland)
ZS9	Botswana Republic (Bechuanland)
1M	Minerva Reef
1S	Spratly Islands
3A	Monaco
3C (See VE)	
3W8, XV5	Vietnam
3Y (see LA)	
4S7 (VS7)	Ceylon
4U1	I.T.U. Geneva
4W1	Yemen
4X4, 4Z (from 14/5/48)	Israel
5A	Libya
5B4 (ZC4)	Cyprus
5H1 (VQ1)	Zanzibar
5H3 (VQ3)	Tanzania
5N2 (ZD2)	Nigeria
5R8 (FB8 Madagasca)	Malagasy
5T5 (from 20/6/60)	Mauritania
5U7 (from 3/8/60)	Niger Republic
5V (F.D.)	Togolese Republic
5W1 (ZM6)	Samoa
5X5 (VQ5)	Uganda
5Z4 (VQ4)	Kenya
6O1, 6O2 (from 1/7/60)	Somalia Republic
6W8 (from 20/6/60)	Senegal Republic
6Y (VP5)	Jamaica
7G1, (from 1/10/58)	Republic of Guinea
7Q7 (ZD6, Nyasaland)	Malawi
7X (FA)	Algeria
7Z (HZ)	Saudi Arabia
8F, (from 1/5/63)	Indonesia
8R (VP3 British Guiana)	Guyana
8Z4	Saudi Arabia-Iraq N.Z.
8Z4 (9K3)	Saudi Arabia-Kuwait N.Z.
9A (MI)	San Marino
9G1, (from 5/3/57	Ghana
9H1 (ZB1)	Malta
9J (VQ2)	Zambia (Northern Rhodesia)
9K2	Kuwait
9L1 (ZD1)	Sierra Leone
9M2 (from 16/9/63)	Western Malaysia
9M6, 9M8 (from 16/3/63)	East Malaysia
9N1	Nepal
9Q5	Republic of the Congo (previously OQ5-0)
9U5 (from 1/7/62)	Burundi
9V1 (9M4, VS1)	Singapore
9X5 (from 1/7/62)	Rwanda Republic
9Y4 (VP4) From 16/9/63 to 8/8/65	Trinidad and Tobago counts as West Malaysia

"DELETED" Countries List

C9 (prior to 1/1/64)	Manchuria
CN2 (prior to 1/7/60)	Tangier
CR8 (prior to 1/1/62)	Goa
ET2 (prior to 14/11/62)	Eritrea
FF8	French West Africa
F18 (prior to 20/7/55)	French Indo China
FN (prior to 1/11/54)	French India
FQ8	French Equatorial Africa
I1 (prior to 1/4/57)	Trieste
I5 (prior to 1/7/60)	Italian Somaliland
JZ0 (prior to 1/5/63)	West New Guinea
PK1, 2, 3 (prior to 1/5/63)	Java
PK4 (prior to 1/5/63)	Sumatra
PK5 (prior to 1/5/63)	Borneo
PK6 (prior to 1/5/63)	Celebes and Molucca Islands
UN1 (prior to 1/7/60)	Kar-Fin. Republic
VO (prior to 1/4/49)	Newfoundland/Labrador
VQ6 (prior to 1/7/60)	British Somaliland
VS4 (prior to 16/9/63)	Sarawak
ZC5 (prior to 16/9/63)	British North Borneo
ZD4 (prior to 5/3/57)	Gold Coast, Togoland
9M2, VS2 (prior to 16/9/63)	Malaya
9S4 (prior to 1/4/57)	Saar
9U5 (from 1/7/60 to 30/6/62)	Ruanda-Urundi

AUSTRALIAN DX CENTURY CLUB AWARD

Objects:

1.1 This award was created to stimulate interest in working DX in Australia and to give successful applicants some tangible recognition to their achievements.

1.2 This award, to be known as the "DX Century Club" Award, will be issued to any Australian amateur who satisfies the following conditions.

1.3 A certificate of the Award will be issued to the applicants who show proof of having contacted one hundred countries, and will be endorsed as necessary, for contacts using only one type of emission.

Requirements:

2.1 Verifications are required from one hundred different countries as shown in the Official Countries List.

2.2 The Official Counctries List will be published annually and will be amended from time to time as required. Should a country be deleted from the Countries List at any time, members and intending members will be credited with such country if the date of contact was before such deletion.

2.3 The commencing date for the Award is 1st January, 1946. All contacts made on or after this date may be included.

Operation:

3.1 Contacts must be made in the HF Band (Band 7) which extends from 3MHz to 30MHz, but such contacts must only be made in the authorised amateur bands in Band 7.

3.2 All contacts must be two-way contacts on the same band. Cross-band contacts will not be allowed.

3.3 Contacts may be made using any authorised type of emission for the band concerned.

3.4 Credit may only be claimed for contacts with stations using regularly-assigned Government callsigns for the country concerned.

3.5 Contacts made with ship or aircraft stations will not be allowed, but land-mobile stations may be claimed provided their specific location at the time of contact is clearly shown on the verification.

3.6 All stations must be contacted from the same call area by the applicant, although if the callsign is subsequently changed, contacts will be allowed under the new callsign providing the applicant is still in the same call area.

3.7 All contacts must be made when operating in accordance with the Regulations laid down in the "Handbook for Operators of Radio Stations in the Amateur Service."

Verifications:

4.1 It will be necessary for the applicant to produce verification in the form of QSL cards or other written evidence showing that two-way contacts have taken place.

4.2 Each verification submitted must be exactly as received from the station contacted, and altered or forged verifications will be grounds for disqualification of the applicant.

4.3 Each verification submitted must show the date and time of contact, type of emission and the frequency band used, the report and the location or address of the station at the time of contact.

4.4 A check list must accompany every application setting out the details for each claimed station in accordance with the details required in Rule 4.3.

Applications:

5.1 Applications for membership shall be addressed to the Federal Awards Manager, Box 2611W, G.P.O., Melbourne, Victoria, 3001, accompanied by the verifications and the check list with sufficient postage enclosed for their return to the applicant, registration being included if desired.

5.2 A nominal charge of 25c, which shall also be forwarded with the application, will be made for the issue of the certificate to successful applicants who are not members of the Wireless Institute of Australia.

5.3 Successful applicants will be listed periodically in "Amateur Radio." Members of the D.X.C.C. wishing to have their verified total over and above the one hundred necessary for membership, listed will notify these totals to the Federal Awards Manager.

5.4 In all cases of dispute the decision of the Federal Awards Manager and two officers of the Federal Executive of the W.I.A. in the interpretation and application of these Rules shall be final and binding.

5.5 Notwithstanding anything to the contrary in these Rules, the Federal Council of the W.I.A. reserves the right to amend them when necessary.

(Continued from page 151)

144MHz hidden transmitter hunt and a barbecue lunch at Lake Wyangan.

Unfortunately, light rain prevented any further field events except a 144MHz hidden transmitter hunt. The day concluded with the presentation of prizes to successful contestants. The prize winners were:—

John Clode	VK2EZ
Stewart McCarthy	VK2ZMQ
Don Haberecht	VK2RS
Leon Skeers	
Tim Mills	VK2ZTM
Peter Campbell	VK2AXJ

On Sunday evening, Neil McNabb, VK2ZCN, his wife and family entertained a number of visitors at their home. All told there were 83 registrations at a most successful event.

(Continued on page 173)

NEW RANGE OF RESISTORS, CONDENSERS AND POTENTIOMETERS

WE HAVE JUST PURCHASED THE COMPETE STOCK OF RESISTORS, CONDENSERS AND POTS. OF A LARGE MANUFACTURER AND CAN OFFER SAME AT LESS THAN 25 PER CENT OF LIST PRICE.

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 200 ohm. to 3meg. in ½, 1 & 2watt also included are I.R.C. 3watt wire wound 2,200 ohm. 3,300 ohm 4,700 ohm. etc.

List price **$9.00** per 100 our price **$2.00** per 100 post & packing 25c extra.

The condensers are in most popular makes and include Polyester, Paper, Mica, Ceramic & Electrolytic in standard values including 4mfd, 8mfd, 16mfd 300V etc.

List price **$11.00** per 100 our price **$2.00** per 100 post & packing 50c extra.

The potentiometers are all current types and include switch pots, dual concentric, 1meg. tandem, ½meg switch, tab pots etc.

List price **$12.00** per dozen our price **$2.50** per dozen post & packing 50c extra.

FREE With each lot of resistors, condensers or pots, we will supply free one new valve type 6U7G, 6X5GT, 1T4, 6K7G, or 12AT7. Resistors, condensers and pots are in packs of 100 or 12 and we regret we cannot supply to individual Lists of values or types.

NEW SELENIUM RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt at 4 amp., $3.75. Post, N.S.W., 20c; Interstate, 20c. Transformer for above rectifier tapped for 6 to 12 volts, $4.75. Post, N.S.W., 75c; Interstate $1.00.
As above, 6 or 12 volt, at 2 amp., $2.75. Post, N.S.W., 35c; Interstate, 45c. Transformer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.

TRANSISTORISED SIGNAL INJECTOR $5.75

A MUST FOR QUICK TROUBLE SHOOTING Using TWO Transistors, complete with instruction sheet and battery. Post free.

NEW VALVES AT BARGAIN PRICES

7193	25c	1T4	45c	6H6G	35c	6SS7 equiv. 6SK7	85c	JA7GT	75c
807	$1.75	3Q4	75c	6K7G	45c	6U7G	45c	1L5G	95c
1C7G	30c	3S4	$1.00	6K8G	68c	6X5GT	75c	12SK7	50c
1D8GT	95c	5V4G	$1.00	6SA7GT	95c	7C7	35c	12A6	50c
1K5G	40c	6C8G	50c	6SJ7	95s	12AT7	$1.00	12K8	50c
1K7G	40c							12SH7	60c
1M5G	40c							866	1.50
1P5G	25c							954	25c
1Q5G	25c							955	25c
								EK32	60c

Please add postage on all valves.

NEW ENGLISH and AMERICAN TRANSISTORS AT 1/4 LIST PRICE

Ideal for the experimenter or service man.
Each package of 12 contains 3 of each of the following types.

PACKET OF 12 FOR $3.00

Mazda XA101.	Equivalent:	OC45 R.F. Transistor.
Texas 2N1108.	"	OC44 OSC. Transistor.
Texas 2N1111.	"	OC75 General purpose
Texas 2N1110.	"	OC45 R.F. Transistor.

THESE TRANSISTORS CAN BE SUBSTITUTED FOR MANY OTHER TYPES.

Post and Packaging 20c extra.

New Electrolytic Condensers

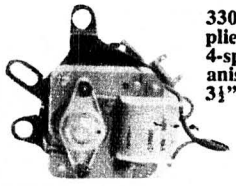
These condensers are miniature pigtail type insulated new stock in packets of 12, each packet containing; 3 16mfd 300 V.W., 2 32 mfd. 300 V.W., 1 25 mfd. 450 V.W. and 6 low voltage electrolytics. **$2.50.**

Post and packing 20c extra.

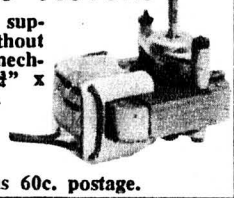
NEW IMPORTED 4" P.M. SPEAKERS

Available with a 4 or 16 ohm voice coil. **$2.00.**
Post and packing 30c extra.

NEW 240V ELECTRIC MOTORS

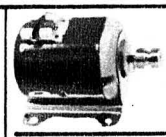


3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3½" x 2½" x 3½", including spindle.



$2.75

plus 60c. postage.



NEW MINIATURE MOTORS

Ideal for models, toys, etc. 1½ to 3 volts. 6,000 r.p.m. 39c each or $3.50 per doz. Post 10c.

NEW MIDGET POWER TRANS. $3.25

40mA prim., 240v. Sec 225 x 225 with 6.3v Fil. Winding.
30mA 240v Prim. Fil. Winding. **Postage: N.S.W. 25c; Interstate 45c.**
150 x 150v. Sec. with 6.3v. **Postage: N.S.W., 35c, Interstate 60c.** **$3.25**

NEW AMERICAN TWIN TELESCOPE TV AERIAL
Extends to 36in, each section can be used singly for car or portable . . . . . **$1.50.** Post 20c.
SINGLE TELESCOPIC Aerial 12in extends to 33in. 60 cents .Post 10 cents.

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools, 2 Track, $35, 4 Track $40.

A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

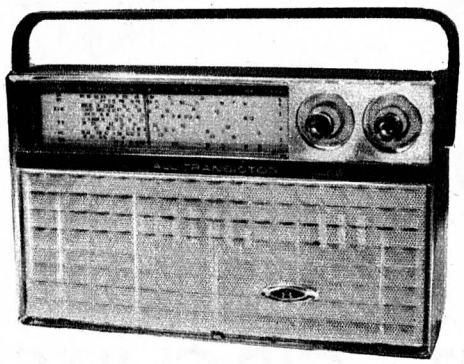
Using 3 silicon transistors as featured in October Electronics Australia complete with kit of parts including transistors mono $7.50, stereo $13.00, 240 power supply for above $7.00.
Please specify if required for pick-up or tape heads.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



DIMENSIONS
9" x 5" x 3" DEEP

(WIRED AND TESTED $6.00 EXTRA)

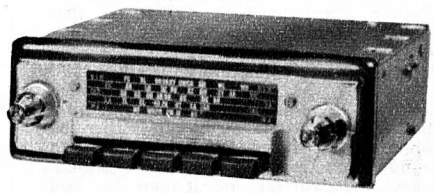
- Complete kit of parts with circuit and full instructions
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black or light green.

Post & Packing extra. N.S.W. $1.25, interstate $1.75.

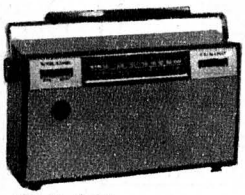
NEW TRANSISTOR CAR RADIO

New transistor six car radios with R.F. stage, of Aust. manufacture using A.W.A. components and transistors.
Available in manual or push-button models with dial calibrated for all Australian States.
Supplied with speaker (5", 6", 5" x 7" OR 6" x 9") and lock-down aerial.

MANUAL MODEL $43.00
PUSH-BUTTON MODEL $48.00
Post and Packing N.S.W. $1.50, Interstate $2.50.



Suitable for 6 or 12 volts for positive or negative earth. Please state type required.



$23.75

NEW TRANSISTOR SIX PORTABLE KIT AT LESS THAN HALF PRICE

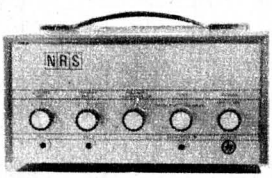
(DESIGNED TO SELL AT OVER $60.00)

Excellent fidelity is obtained in this new kit set by the use of large speaker and polished timber case with attractive gold metal front panel. By using heavy duty batteries it is economical to operate and is ideal for portable use or that second set. Complete kit of parts is supplied with full instructions.

Post and packing N.S.W., $1.25—Interstate, $1.75.

NEW 25 AND 35 WATT. P. A. AMPLIFIERS

THESE AMPLIFIERS ARE SUITABLE FOR INSTALLATION IN CLUBS, SCHOOLS, RESTAURANTS, HOTELS, FACTORIES, ETC., WHEREVER THE AMPLIFICATION OF SPEECH OR MUSIC IS REQUIRED.

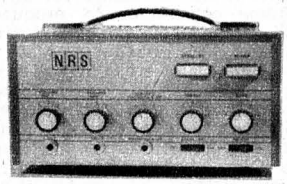


STANDARD AMPLIFIER

25W $61.00 SPECIFICATIONS 35W $71.00

Nominal power 25 or 35 watts. ● Inputs two microphone and pick-up or radio with separate controls and mixing facilities. ● Tone control. ● Microphone sensitivity 6MV. pick-up or radio 150MV. ● Frequency response 30 to 18,000 CPS. ● Output impedance Line output (100, 166, 250, 500 ohms) or can be supplied with V.C. output (2, 3, 7, 8, 15 ohms). ● Dimensions 11in x 6in x 8in. Weight 25W 23lb. 35W 26lb.

SEPARATE BASS AND TREBLE CONTROLS



AMPLIFIER WITH BASS and TREBLE CONTROLS

All amplifiers can be supplied fitted with a separate tone control stage with separate bass and treble controls and stand-by switch at $5.00 extra.
All amplifiers are too heavy to be sent by parcel post so can be sent by air freight or rail or road transport.

FREIGHT EXTRA.

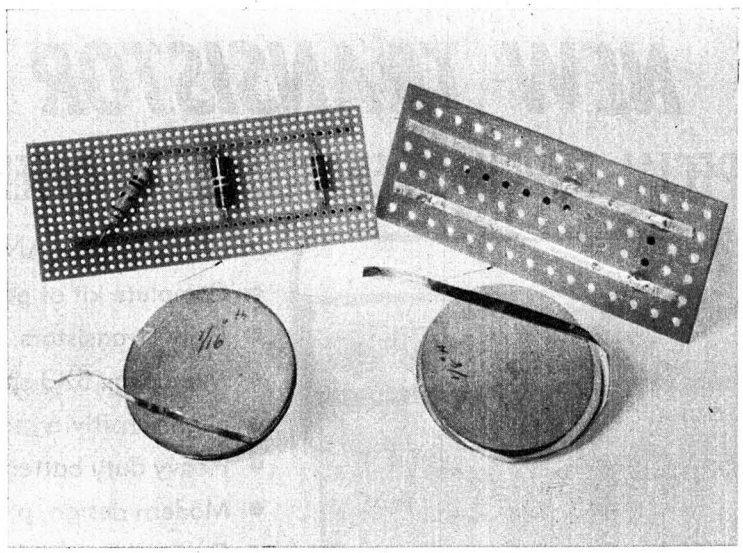
NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

DESPITE the initial reservations felt by many people, particularly with reference to servicing, the printed circuit is now firmly established in most types of electronic equipment, ranging from the incredibly cheap pocket radios that have flooded the country in recent years, to some of the most sophisticated professional equipment available. Its origins lie in weaponry — a heritage unfortunately common to many good "electronic" ideas, but printed circuitry is, and indeed has been for some time, an attractive system for the amateur who constructs his own equipment, for it solves the mechanical problems of component mounting and eliminates the chores of wiring — as well as facilitating a neat and workmanlike job. For the amateur who has so far shied away from etching his own boards, a new system is now available, which is both economical and easy to use, yet with care, is capable of excellent results. Known as **Cir-kit**, the system utilises bakelite boards, similar to those used commercially, in conjunction with self-adhesive copper strip. This is 1/16in or 1/8in wide — easily cut with scissors or a model knife — and attaches to the boards rather like a piece of **Sellotape.** The adhesive is very efficient, although the bond is not quite as good as that on pre-laminated boards — which means that care is needed when soldering not to overheat the copper. However, anyone who is competent to solder a transistor or capacitor without causing damage should have no trouble, and the adhesive improves with aging, so that long-term stability is satisfactory. Layouts can normally be planned using the theoretical circuit diagram as a guide, and boards may be pre-punched or drilled according to requirements. With the pre-punched board, the strip can either be laid over the holes, and then punched through with a small drill or a watchmaker's screwdriver, or it can be laid alongside the holes and component leads are inserted through the board, folded over and soldered (see photo). The former method permits a more compact layout.

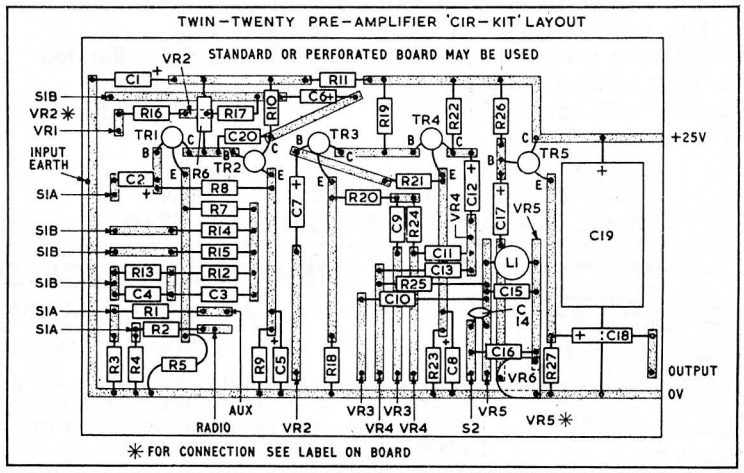
A few tips on planning layouts. Always be sure that the component spaces you allocate are adequate — it is preferable to purchase the bits before embarking on this task, although capacitors are available in literally dozens of shapes for board mounting and resistors are more or less of standard size, dependent on ratings. Avoid siting adjacently on to your layout components which are in different stages —as this can lead to instability. If instability does occur, of course, **Cir-kit** does permit alterations to be made, although it is as well to investigate the problem before redesigning sections of the board for it may not prove necessary.

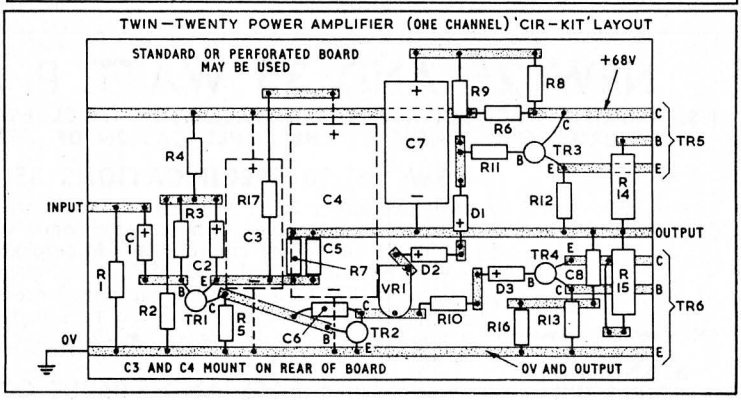
The excellence of the system, however, lies in its versatility, for it enables the home constructor to produce a wiring board on a one-off basis for most of the circuits described in this and other journals, and while it will no doubt encourage many to "try their hand," it will also enable many who already build their own equipment to achieve neater, more reliable results with a minimum of fuss.



INSTANT CIRCUITS

A new method of making component boards using self-adhesive copper strip.





AVAILABLE ALL LEADING RADIO HOUSES.

(SOLE AGENT)

ZEPHYR PRODUCTS PTY. LTD.

70 BATESFORD ROAD, CHADSTONE, VICTORIA—PHONE 56-7231

MANUFACTURERS OF RADIO & ELECTRICAL EQUIPMENT & COMPONENTS

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Radio Tarawa Extends Schedule

Extension of program times and changes in the callsigns have been noted from Radio Tarawa, operated by the Gilbert and Ellice Island Broadcasting Service.

In the past the station used VTW on 845KHz medium wave and VTW2 on 4912KHz short wave. These calls have been changed to VSZ-1 on 945KHz and VSZ-2 on 4912KHz. The program has been extended from the one-night-a-week (Thursday) transmission to a daily service from 0700 to 0920GMT. Also, a breakfast session in English is on the air Tuesday to Saturday from 6.45 to 8.00 a.m. Tarawa time (Monday to Friday 1845-2000GMT). The programs are now carried as follows, being broadcast simultaneously on both frequencies.

Daily
0700-0745, Gilbertese.
0745-0830, Ellice.
0830-0920, English.

Monday to Friday
1845-2000, English.

The program in English each evening, 0839-0920GMT, includes news relayed from Radio Australia at 0900GMT and then follows local news, shipping and weather. The station closes with the National Anthem. Some sideband interference from the Brisbane transmitter on 4920KHz is noted, but in New Zealand this is not very severe.

YVOC NOW ALL NIGHT

A further all-night transmission in the 60-metre band is being noted, with YVOC, Ecos del Torbes at San Cristobel, Venezuela, now operating a 24-hour service on 4980KHz. The station gives frequent identification in its program of popular music, and news has been noted at 0945GMT. A further frequency, 9640KHz, also carries the same program in parallel, but this channel is blocked at this time by the B.B.C. London and later by Seoul, South Korea. The 60-metre band all-night Latin Americans are now:

KHz	Station
4940,	Radio Colossal, Neiva, Colombia.
4965,	Radio Santa Fe, Bogota, Colombia.
4980,	Ecos del Torbes, San Cristobel, Venezuela.
5020,	Radio Manizales, Manizales, Colombia.
5045,	Radio Altaplana, La Paz, Bolivia.

DAMASCUS USING 5960KHz

A new frequency for the Syrian Broadcasting System, Damascus, is 5960KHz, which now carries the extended service for listeners in Europe. Transmission in New Zealand has been heard on 5960KHz at 1930 in English, and on the other short wave frequency 15160KHz at 2100GMT. The station also announces that medium wave frequencies of 863, 944 and 1313KHz also carry the program.

The times of the various language broadcasts from Damascus are:

GMT	Language
1700-1730	German
1730-1800	Russian
1800-1930	French
1930-2100	English
2100-2200,	Arabic

QUATAR VERIFIES

The new station operated by the Quatar Broadcasting Service, at Doha, has confirmed the reception of its programs as received by Geoff Stewart, Christchurch, N.Z., in the form of a letter. The station carries programs in Arabic on 9570KHz, and is best received at night around 1500GMT. The full schedule is 0330-0700 on Friday, and 0300-0500 and 1400-1730GMT daily.

BROADCASTS FROM THE VATICAN

Some changes have been made by Vatican Radio in its two services to Australia and New Zealand, in order to get clear channels. The 2200GMT service is now using 9670KHz and though signals are good some interference is noted from Saudi Arabia on the same frequency. The 1130GMT transmission is now using the 16 and 13-metre bands in order to provide a fair signal during our summer months. The service is now:
2200-2215, 9670, 11745, 15155.
1130-1145, 17820, 21690.

The frequency of 11745KHz was replaced by 11705KHz for a trial period, but returned to 11745KHz due to interference on the other frequency from Radio Sweden in Stockholm.

NZRDXL CELEBRATES 20th YEAR

The New Zealand Radio DX League recently celebrated its 20th anniversary and produced a special issue of its monthly magazine, "The New Zealand DX Times," which reviewed the hobby during the past 20 years. In fact, before its establishment in 1948, the League was the New Zealand DX Club, which dates back to 1932. The League had many members in Australia and it was these members who were given assistance to establish the Australian Radio DX Club.

LOOKING BACK THIRTY YEARS

Our short-wave correspondent, Art Cushen, has been looking through his old log books, and here he reminisces about broadcasting as he remembers it some 30 years ago.

Looking back at my log books some 30 years ago, one can trace the operation of international short-wave stations from their humble beginning in those days.

In the United States in 1939 all stations were experimental and stations such as W3XAL later became WRAC and now The Voice of America at Bound Brook, New Jersey. Other stations such as WIXK Boston became WBOS, and W8XK Pittsburg became WPIT before they closed in 1940. Miami, Florida had a station W4XB, and there were many others located in various cities which relayed the broadcast band program. The highest frequency ever received was that of W4XA in Nashville, Tennessee, which relayed the well-known WSM. This station operated an experimental service on 26150KHz with the power of 1,000 watts, and was above the authorised 11 metre band as we know it today. On the west coast, such stations as W6XBE were in operation. This station later became KGEI—while KRCA and KNBH and many other calls were used before The Voice of America took over the present Dixon and Delano, California, transmitters.

In Canada, the C.B.C. operated a short-wave service with relays of the broadcast band program, and such stations as CBFX with 7,500 watts were frequently heard until replaced by Radio Canada. Many Canadian stations of low power were also heard including CKFX in Vancouver with 10 watts, CFVP in Calgary with 100 watts, and CKZN with 300 watts.

During and after the war many interesting calls were heard, including KZCA Salzburg, Austria, an American Forces Station and WLKS in Kure, Japan operated by the British Forces. Other calls received included ABSIE (American Broadcasting Station in Europe) operating from Britain, and FBS (Forces Broadcasting Service) from Cairo, Tripoli, Benghazi and many other points, and Radio SEAC in Ceylon.

The main deterrent to listening in those days was not the general reception conditions, but the lack of information from DX organisations, as all material came by sea mail and we had no such thing as handbooks, DX sessions and the fast communication of news that we have today. It was not until 1948 that Radio Australia and Radio Sweden commenced their DX sessions.

On the broadcast band the lack of local stations made is possible to hear many signals, and these included 100 to 250 watt stations from North America, at regular intervals. Some of the other low-powered stations heard included The Voice of the Eighth Army in Italy with 800 watts, all India Radio, Shillong, with 50 watts, and 5AL Alice Springs with 30 watts. These days because most channels are in use by New Zealand and Australian stations, medium-wave reception is much more difficult. Nevertheless, readers continue to report interesting stations in all parts of the world on both medium and short-wave and signals from Africa and South America still provide fascinating reception on very low powers.

LEADER TEST INSTRUMENTS

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SPECIFICATIONS:

Vertical Axis	
Deflection sensitivity	10mVp-p/cm or better.
Bandwidth, at — 3dB	DC: DC to 10MHz. AC: 2Hz to 10MHz.
Input impedance	1M , 35pF in shunt.
Input control	X1, X10, X100, X1000 and fine adjuster.
Calibration voltage	0.05Vp—p at line frequency.
Horizontal Axis	
Deflection sensitivity	300mVp—p/cm or better.
Bandwidth, at — 3dB	DC: DC to 500kHz. AC: 2Hz to 500kHz.
Input impedance	1M , 50pF in shunt.
Input control	X1, X10 and fine adjuster.
Sweep Circuit	
Frequency	1Hz to 200kHz in six steps; H-TV at 15.75kHz/2.
Synchronization	INT & —, EXT and LINE.
Phasing control	0 to 140°, variable, line frequency.
Power Supply	100, 115 or 230V as specified, 50/60 z; 85VA approx.
Size and Weight	270(H) X200(W) X420 (D) mm, 11kg.
Accessory	10: 1 low capacitance probe with cable (LPB-1Z) 1 ea.

MODEL LFM - 35
WOW & FLUTTER METER

SPECIFICATIONS:

Test center frequency	3kHz 5%
Input impedance	100k Ω approx., one side grounded.
Input level range	20mV to 5V rms.
Wow range	0.01% to 3% in three ranges: 0.3%, 1% and 3% full scale; accuracy within 10% full scale.
Drift range	0 to — 5% and 5%; accuracy within 10% full scale.
Weighting characteristic	in accordance with JIS C5551 specifications.
Filters (built-in)	Wow: 0.2 to 6Hz. Flutter: 6 to 200Hz.
Oscillator section:	
Frequency	3kHz.
Output voltage	1 volt rms; output impedance approx. 1kHz
Distortion	less than 1%
Power supply	100, 115 or 230 volts as specified; 50/60Hz; 3VA approx.
Size and weight	200(H) X 150(W) X 250 (D) mm; 3.5kg approx.

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ALL STATES.

The administration office of the New Zealand Radio DX League is now P.O. Box 5165, Dunedin. Annual subscription is $2. The League's magazine, "New Zealand DX Times," is published in Christchurch and the editorial office is P.O. Box 1356, Christchurch.

The League has five life members: Messrs K. A. Mackay (Auckland), D. L. Lynn (Christchurch), J. F. Fox (Dunedn), A. M. Banks and A. T. Cushen (Invercargill) Sample copy of the "DX Times" can be received from the League's Public Relations Officer, A. T. Cushen, 212 Earn Steet, Invercargill, New Zealand.

SOMETHING FOR NOTHING

In continuation of our item last month, we list below further pamphlets and other material, which is being sent free of charge to listeners on request.

CANADA

CHU. Time Service Bulletin B-16, about CHU services. From CHU., Department of Mines and Technical Surveys, Dominion Observatory, Ottawa, Canada.

"Canada Speaks To The World." Four-page folder from the C.B.C., P.O. Box 6000, Montreal.

GERMANY

Frequency list. Has 63 pages in German, but can be used quite well, even if you read only English. From Sender Freies Berlin, Programdirektion (Horfunk) D1, Berlin 19, German Federal Republic.

AUSTRALIA

"Constant Voice," a 46-page booklet on Radio Australia's 25th anniversary. From the various Radio Australia stations.

SWEDEN

List of Radio Countries. From DX Alliansen, P.O. Box 3108, Stockholm, Sweden.

Weekly DX bulletin, "Sweden Calling DXers," from Radio Sweden.

DENMARK

Free sample of the "World Radio Bulletin" from World Publications, Lindorfsalle 1, Hellerup, Denmark.

GREAT BRITAIN

Booklet on aerials is available from the External Transmission Section, B.B.C. Bush House, London, W.C.2, England. Also details on how to join the B.B.C. World Radio Club.

HONG KONG ABANDONS SW

Radio Hong Kong, which for more than 30 years has been received on shortwave, no longer transmits on the SW bands. A letter from the station states that the two medium-wave transmitters have been increased to 20KW and this has resulted in improved reception of the local coverage. The shortwave service has therefore been terminated, because coverage from the medium-wave stations is now sufficient. Our first verification from ZBW2 in Hong Kong was in 1939. The station was then operating on 9525KHz but in recent years all its transmissions have been on 3940KHz in the 75-metre band.

In 1939, the station card, showing a picture of the transmitter and studio buildings, showed the station as using 9525KHz, also 640, 845KHz on medium-wave and 6090, 15190 and 17755KHz on shortwave. Medium-wave and shortwave stations both used 2.5KW. The station was then operated by the Hong Kong Government and carried programs in English and Chinese.

DEUTSCHE WELLE EXPANSION

Recently, two more 100 KW shortwave transmitters were installed at Julich for Deutsche Welle transmissions. Now, 10 shortwave transmitters are located at this site, each of 100KW. One of these is not used in regular broadcasts, being kept as a standby unit. The total output is

NEW SCHEDULES OPERATING

RADIO FIJI

The latest schedule for Radio Fiji as carried on the transmitters of the Fiji Broadcasting Commission, is as follows:

Medium Wave

GMT	KHz	Location	Language
1800-1030	560	Suva	English
1800-1030	1320	Lautoka	English
1800-1030	710	Suva	Fijian, Hindi
1800-1030	890	Lautoka	Fijian, Hindi
1800-1030	930	Nadroga	Fijian, Hindi
Short Wave			
1800-2115	3230	Suva	English
0345-1030	3230	Suva	English
2115-0345	6005	Suva	English
1800-2130	3284	Suva	Fijian, Hindi
0330-1030	3284	Suva	Fijian, Hindi
2130-0330	5955	Suva	Fijian, Hindi

On Saturdays, all programs are extended to 1100GMT. During Sunday morning in Fiji (2000-2400GMT Saturday) a Sunday Supplement is broacast on 840KHz on medium wave and 4756 on short wave.

FEBC MANILA

The Far East Broadcasting Company in Manila is now using the following schedule for all language transmissions:

GMT	KHz	Language	KW
2030-1615	6030	English 2030-1330	2
2130-2245	6120	Mandarin	50
2130-2330, 1330-1730	7225	Mandarin, Amoy	3
2215-2345	9505	Vietnamese, Cambodian	50
2130-2315, 1145-1730	9715	Mandarin, Amoy	10/50
1615-1730	11855	Thai, Lao, Russian	50
0815-1030	11890	English (0845-1000)	50
2115-2330 1000-1615	11920	English (1130-1230)	50
2330-0700, 0815-1615	15300	English (2330-2400, 0100-0700)	10
2330-0300	15385	English (2330-0030)	50
2345-0100, 0300-0700	15440	English (0300-0700)	50
0815-1130, 1245-1630		English (0815-0930)	
2145-2345, 0000-0600	17810	English (2145-2345)	2
0815-0945, 1000-1130		English (0100-0600)	
		English (0815-0945)	50
0100-0700, 0845-0945	21515	English	2

BROADCASTS FROM OSLO

Radio Norway at Oslo has several 90-minute programs in Norwegian each day, and on Sunday the last 30-minute session is in English. The transmissions to North America carry this program on Monday (GMT day).

GMT	KHz	Area Served
0700-0830	11735, 21730, 25900, 25720, 21655	Australia, New Zealand, Indonesia.
1100-1230	7210, 11850, 25730, 25900, 21655	Australia, New Zealand, India.
1300-1430	9645, 25900, 21730, 21655, 25730	Australia, India, Africa.
1500-1630	21655, 25730, 25900, 21730, 17825	North and South America.
1700-1830	15175, 21655, 21730, 25900, 25730	Africa, and South America.
1900-2030	11735, 25730, 21730, 11850, 15175	Africa.
2100-2230	11850, 11860, 15175	North and South America.
2300-0030	11850, 9645, 11735,	East Africa and South America.
0100-0230	9645, 9550 9610	North America.
0300-0430	9550 9645, 9610	North America.

ENGLISH FROM BERNE

The latest schedule of the Swiss Broadcasting Corporation, Berne, Switzerland, in effect until May 3, 1969, is as follows:

GMT	KHz	Area Served
0700-0800	9590, 11775	Australia and New Zealand.
0700-0800	6165, 9535	Europe.
0845-0945	11775, 15135	Japan and China.
1000-1100	15305, 17885, 21520	Africa
1130-1230	9665, 11865	United Kingdom, Ireland.
1315-1415	15305, 17845, 21520	S.E. Asia, India, Pakistan.
1500-1600	15305, 17830	Near and Middle East.
1815-1915	11775, 15305	Africa.
1930-2030	6015, 9665	United Kingdom, Ireland.
0130-0230	6120, 9535, 11715	North America (East)
0445-0545	6120, 9720	North America (West)

VOICE OF NIGERIA

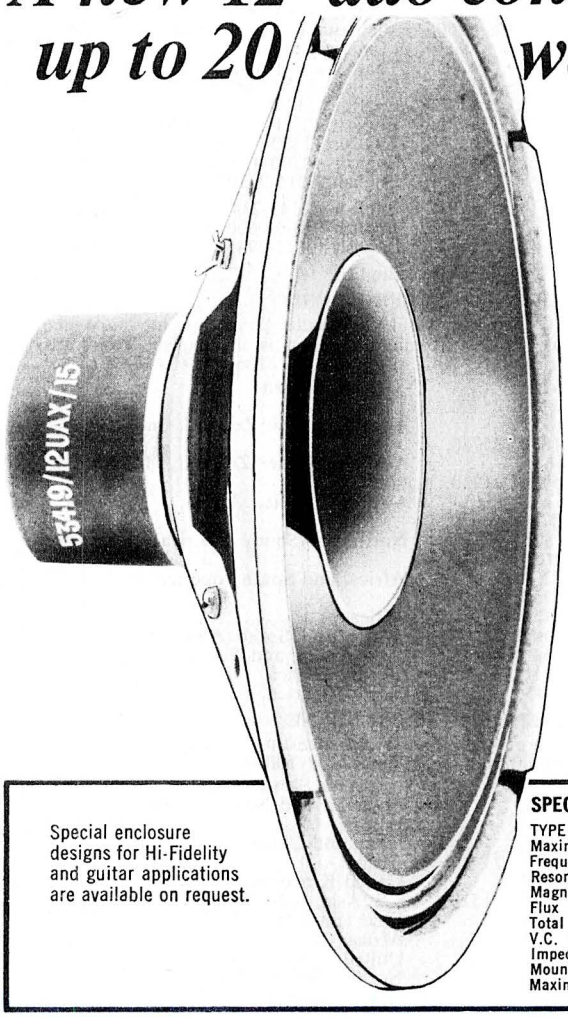
The Voice of Nigeria at Lagos, is operating to the following schedule:

GMT	KHz	Language
0545-0730	21455, 15255, 7275	English
1300-1400	9690, 7275, 21455, 11770	French
1400-1500	15255, 9690, 7275, 11750	Hausa.
1500-1600	9690, 21455, 7275, 15255	English
1600-1700	15255, 21455, 7275	Arabic
1700-1900	21455, 7275, 15255, 11770	English
1900-2100	9690, 7275, 15255, 11770	French
2100-2200	15255, 9690, 7275, 11770	English

ONE OUT OF THE BOX

This new speaker combines rugged bass diaphragm with a coaxially radiating high-frequency flare to give excellent wide-range performance. This basic unit has been extensively tested in both high-fidelity and guitar applications and has now been matched with its own specially designed high-frequency flare resulting in an extended range of 45 to 12,000 Hz while maintaining a power rating of 20 watts (15 watts for guitar applications.) The Hi-Flux magnetic system and matched voice coil gives this unit full rich bass and extended treble performance for hi-fi, stereo or guitar applications.

A new 12" duo-cone speaker that handles up to 20 watts on extended range



MSP Hi-Flux SPEAKER

TYPE 12UAX

The three versions of this 12" speaker are an extended range type 53419/12UAX/15 with a frequency coverage of 45-12000 Hz and two general purpose speakers type 53348/12UA/15 and 53422/12UA/8.

Special enclosure designs for Hi-Fidelity and guitar applications are available on request.

SPECIFICATION

TYPE NUMBER	53419/12UAX/15	53348/12UA/15	53422/12UA/8
Maximum Power Handling	20W (15W for Guitar)	20W (15W for Guitar)	20W (15W for Guitar)
Frequency Range	45-12000 Hz	45-6000 Hz	45-6000 Hz
Resonance	50 Hz	50 Hz	50 Hz
Magnet Material	Alnico V	Alnico V	Alnico V
Flux Density	13,000 gauss	13,000 gauss	13,000 gauss
Total Flux	100,000 lines	100,000 lines	100,000 lines
V.C. Diameter	1¼"	1¼"	1¼"
Impedance	15 ohms	15 ohms	8 ohms
Mounting Hole Centres	11¼" P.C.D.	11¼" P.C.D.	11¼" P.C.D.
Maximum Depth	4¼"	4¼"	4¼"

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therefore 900KW. A 250KW transmitter, located at Kigali, Rwanda, is also used. During 1969, Julich will have a further 250KW transmitter added and in 1970 two more 250KW transmitters will be put into service at a new Deutsche Welle relay base in Portugal.

Tentative plans exist for further relay stations in Central America and South-East Asia, as reported in a previous issue.

CHANGES AT ARDXC

The Australian Radio DX Club advises that all inquiries regarding membership should be forwarded directly to the Honorary General Secretary, 22 Howard Street, Glen Iris, Victoria, 3146, who will supply full details regarding the club and its activities. The club's monthly bulletin, "The Australian DX News," caters for all aspects of DX listening, including shortwave and medium-wave. Editorial address is P.O. Box 227, Box Hill, Victoria, 3128.

"World At Your Fingertips," the weekly DX program at 1235GMT every Sunday evening over station 3NE, Wangaratta, 1600KHz, is produced by the Victorian and South Australian branches of the club. The broadcast heard on the second Sunday each month is prepared by the South Australian branch with Robert Chester as spokesman, while all other programs are produced by the Victorian branch, with Bob Padula as spokesman.

RADIO AUSTRALIA EXTENDS SCHEDULE.

Radio Australia, Melbourne, recently extended its schedule of programs to the Pacific and now gives a continuous service from 1800-1215. Other schedules also have been altered, new frequencies put into service, and all these changes are listed below.

To New Zealand and South Pacific Islands

GMT	KHz
1800-2200	11810
0200-0800	15240
0745-0915	9560

To Mid Pacific Islands

1800-2200	9540
1800-0030	11840
2000-0830	15180
0830-1215	7190

To South and South East Asia

2212-0100	15220
2245-0930	17870
0100-0800	21540
0830-0930	15320
0930-1500	9570
1500-1730	9540

To East Asia and North Pacific Islands

2100-2300	17715
2100-0000	15240
0900-1000	11810
1100-1215	11810
0900-1400	15140

To North America and Central Pacific

0100-0300	15320, 17840, 21740

To North America (East Coast)

1115-1215	9580, 11710

To British Isles and Europe

0645-0745	9560, 11710

To Africa

0330-0500	15320, 17820

PARIS USING 11970KHz

Good signals are being received from ORTF in Paris on their new frequency of 11970KHz. This transmitter is on the air from 0515 to 0530GMT with programs also carried on 9700KHz. The station announces that this English service is being relayed by the Brazzaville station in the Congo on five frequencies.

FLASHES FROM EVERYWHERE

EUROPE

FRANCE: ORTF in Paris has transmissions beamed to Brazzaville, in the Congo, for rebroadcast by the relay station there. The English programs from Paris are now on the air:

GMT	KHz
0515-0630	9700, 11975
1100-1115	15170, 21650
1915-1930	15380, 21680

GERMANY WEST: Radio Deutsche Welle, in Cologne, has made some frequency changes and two affect the service to Australia and New Zealand. The new frequencies are:

GMT	KHz	Language
2110-2200	15275	English
0645-0945	9650	German

In addition, a service in English, 0840-0945GMT, is on the air on 15275, 17845 and 21650KHz.

LUXEMBOURG: Radio Luxembourg has transmissions in English from 1830 (Sunday 1800) to 0200GMT on 1439-KHz medium wave and from 1900-GMT on 6090KHz shortwave. German is on the air from 1200 (Sunday 1300) to 1800GMT, on 6090KHz. French is carried on long wave, and on short wave 15350KHZ, from 0500-1200GMT, while Dutch is carried daily 0800-1100 (Sunday, 0630-1300GMT) on 1439 and 6090KHz.

BELGIUM: Radio Brussels, with its English program, "Belgium Speaking," is broadcast as part of the transmission, which is carried mainly in French and Flemish. The English programs are scheduled at:

GMT	KHz
2205-2215	6010, 9615, 15335
0050-0100	6010, 6125, 11885

A mailbag session is carried in the English program on Thursdays and pennants and coloured verifications are available for reports. English programs are planned to be extended in the future.

ASIA

IRAQ: Radio Baghdad, Iraq, has commenced a test transmission in Arabic on 11850KHz. This has been received at 2125 to 2210GMT in Europe. Radio Baghdad now broadcasts in nine languages and transmissions total 37 hours a day. The transmissions are on 6030 and 6095KHz, each with 100KW, and are in English 1930-2020GMT, German 2020-2110, French 2110-2200GMT.

LEBANON: Radio Lebanon, Beirut, now uses 15440KHz to North America with a full transmission 0130 to 0400GMT. English is received 0230-0300GMT. The station returned to this frequency from 15285KHz recently. Interference was experienced on 15285KHz from Radio Havana, Cuba, forcing Lebanon to return to 15440 KHz.

MALDIVE ISLANDS: The present schedule for the Maldive Island Broadcasting Service, as reported in the "Australian DX News," is:

GMT	KHz	KW
0600-0700, 1300-1700	1507	7
1300-1500	3331	15
1500-1730	4740	30
0300-0500, 1000-1300	6150	2.5
0100-0300, 0900-1100	7150	2.5
0700-0900	9552	15

(Continued on page 166)

BROADCAST BAND NEWS

Recent news of the broadcast band is the closing of the B.B.C. relay base at Malta, on 1178KHz. The Central African Relay at Francistown, Botswana, has also ceased operation, according to the "New Zealand DX Times." A new station for Abu Dabi Broadcasting Service, is advertising for a senior broadcasting engineer to supervise the installation and operation of an extensive broadcasting facility, including a high-powered medium-wave transmitter, located in one of the Trucial States on the Persian Gulf.

LAOS: According to an A.B.C. news bulletin, a new broadcasting network has opened with the help of Britain and Australia under the Colombo Plan. Australia supplied three transmitters, two of them installed at Vientiane and the other at Luang Prabang.

MALDIVE ISLANDS: The Maldive Island Broadcasting Service on 1507KHz has increased power to 7KW.

SPAIN: The latest schedule of Radio Nacional Espana shows the following changes: National Program has a new station at Zaragoza on 1313KHz, scheduled 0600-0030 with 10KW. Radio Peninsular, Sevilla, formerly on 1313KHz, has now moved to 1187KHz, scheduled 0600-0015 with 5KW. Valencia, 1079KHz, now 0630-0100GMT.

GERMANY WEST: Next month the Bayerische Rundfunk, Munich, will replace the five MW transmitters operating in chain on 1602KHz by a new transmitter of 400KW, according to a report in "Sweden Calling DXers." On 800KHz, a new 100KW transmitter at Nuremberg is planned. This month Sender Langenberg of Westdeutschen Rundfunk, Cologne, will have an output of 800KW on 1586KHz. A 400KW transmitter of Europawell Saar, on 1421KHz will be increased to 600KW in February.

NOTES FROM READERS should be sent to ARTHUR CUSHEN, 212 Earn St., Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney and 12 hours for Wellington. All frequencies in KHz.

THAILAND: A verification from Station 909 at Sakon Nakorn, Thailand, has been received by Robin Chambers, Opunake, N.Z. Station 909 is on 843KHz, and they expressed surprise and delight at being heard in New Zealand. They have been in operation for over a year and use the power of 50KW. The station broadcasts from 2300-1500GMT with a break of two hours in the afternoon for generator maintenance. It is staffed by the National Security Command of the Thai Government and the transmitter was a gift from the United States. The station provides a program for the villages in the north-east of Thailand. Before 909 came into being the people had a choice between Peking and Hanoi.

CONGO: Three 300KW stations are to be set up at Kinshasa, Lubumbashi and Kisingani, and two 10KW stations at Matadi and Bandundi.

SUDAN: Two 120KW stations at Soba are now in operation.

COSTA RICA: According to a short-wave verification received by Dene Lynneberg, Wellington, N.Z., Tirica at San Jose is now using 1000KW on 625KHz.

UNITED STATES: The Federal Communications Commission has frozen all applications for new medium wave stations. The reason announced is that the F.C.C. wants time to evaluate future policy in the medium wave service area; and will accept no more applications until it has decided whether there is a significant need for new stations.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- ***Please give your name and full postal address, including the State and Postcode.***
- ***Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.***

DISSATISFIED READER. Having been a reader for approximately 18 years I wish to thank you, first for the way in which your magazine aided me in the choice of a career; second for the way in which it helped me during my training; third, for the many ways it assisted me in earning my living. I wish your magazine all the best in the wonderful world of electronics in Australia. I recommend your magazine to the young lads interested in electronics, both in my work and my hobby, almost as a "radio bible" in Australia. I point out that most of the components used are readily available in Australia. As a licensed amateur and interested mainly in such, I sometimes feel that the projects in your magazine hold little interest for me (Hi-Fi, model trains, etc.) so I am cancelling my subscription for a regular copy. Rest assured that I will look through your magazine every month at my local newsagent, and if there is a project on amateur gear, or something else of interest, I will surely buy a copy. **(S.M., Elizabeth Downs, S.A.).**

● We are sorry you feel strongly enough about projects that do not interest to see fit to cancel your subscription, S.M., but you will realise that we have to cater for all interests in the widespread subject of electronics. We should have thought that anybody who earns his living by electronics would find the general articles and news pages of assistance in keeping up to date with new developments; this quite apart from constructional projects.

AUDIO AMPLIFIER: Would it be possible for you to put an article in your magazine for an amplifier (about 5W) using valves which is easy and inexpensive. **(G.H., Gymea, N.S.W.).**

● You have not said whether you want a mono or stereo amplifier, G.H., but we have already published circuits for both to meet your output power requirement. The Basic Mono Amplifier (May, 1967) and the Basic Stereo Amplifier (June, 1966) both give an output of the order you require and are simple, economical designs. The Playmaster 118 Stereo Amplifier (July, 1967) is the latest of our valve quality amplifiers if you want a circuit to give hi-fi reproduction. Copies of the articles describing these projects are available through the Information Service for 20c each.

HEAD DEMAGNETISER: Have you ever featured a "tape head demagnetiser" as a home constructor's project? If not, can you consider doing so in the near future? What is the difference in "modus operandi" of a single probe demagnetiser compared with a double probe demagnetiser? Is one better than the other? Do different makes of tape recorder require different types of demagnetisers? **(I.M.S., Cannon Hill, Brisbane).**

● For the best results, it is likely that different makes of tape recorder would require different types of head demagnetiser. We therefore recommend that information on the best type to use for a particular recorder be sought from the makers (or importers). Using an unsuitable type could well lead to inceased magnetisation of the head, due to current induced into the head coils being rectified by internal circuitry. We could not say that either the single or double probe type is best. Some makers favour the single probe, others the double probe. Presumably each is the best for use with the particular recorder for which it is intended.

BEGINNER'S PROBLEM: I have just completed the "ABC Three" receiver, which I chose for my first attempt at valve construction because of its simplicity. Thank you for publishing this and other beginner's articles. I am wrapped in the "3-Plus-3" stereo amplifier but the problem of obtaining the necessary loudspeakers, record player and tuner worries me. Individually, these could set me back as much as the amplifier itself. After a pat on the back and a grouch, thank you very much for an excellent publication. **(A.C., Footscray, Vic.).**

● Thank you, too, for your appreciative remarks. We can't do much about the prices, unfortunately. While it is a good thing to aim for the recommended items, sometimes lack of funds forces compromises. Keep your eye on the clearance sales and you may pick up a player and loudspeakers which will serve your purpose, without costing you the world.

SHORT-WAVE CRYSTAL SETS: I congratulate you on a splendid magazine. I am writing to say that short-wave crystal sets are possible as I have seen the circuit for one published. **(K.H., Cheltenham, Vic.).**

● We have covered this point a number of times in these columns and elsewhere. Crystal sets can be fitted with coils having fewer turns of thicker wire, so that they will tune over sections of the short-wave band. If very powerful signals happen to be available on the bands, they may be heard from time to time. The essential point is that, on the broadcast band, in well served areas, signals are available for most hours of the day and night. On the short-wave bands, the chances of a strong enough signal turning up are much lower. But you can be lucky. It's as simple as that.

PLAYMASTER 118: In your article, you mention the use of a low radiation power transformer. Is it possible to modify a conventional transformer by adding a copper strap and where should it be placed? Also, can you explain the limit of 10 KHz on Australian broadcast stations? **(G.J., Ballarat, Vic.).**

● The copper strap should be about the same width as the winding and goes around the winding but OUTSIDE of the core, NOT through the core window. It can be a fairly light gauge copper but must be soldered right along the seam where it laps. Such a strap tends to short-circuit the field which is not contained within the core proper and therefore reduces radiation. The sidebands from AM stations tend to overlap and cause mutual interference. The 10 KHz limit is an arbitrary one, imposed in an effort to minimise the so-called "monkey chatter" which results.

CAR RADIO: I believe the last kit-set car radio published in "Electronics Australia" was the up-dated version of the Kar-Set. Although this was a good circuit and worked well it lacks attractiveness and is not available as a push-button set. When I attempted to buy a dial assembly for a car radio, I found they are usually attached to a chassis and cannot be purchased unless a broken one is returned. Can you suggest where I might obtain an attractive dial, or if not, would you be able to design a more attractive kit-set car radio? **(S. D., Townsville).**

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issues from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra in all cases.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W., 2001. Other correspondence should be directed to The Editor. 9/67

● We have no plans for a push-button car radio, mainly for the reasons expressed in your letter, S.D. — the non-availability of suitable dial units for home constructors. We are not surprised manufacturers of car radios will not supply dial assemblies to home constructors, since these usually carry the set manufacturer's name or trademark, which he wishes to be associated with his set only.

DEAD LETTER: We are holding a letter addressed to Mr I. Fletcher, 125 Orchardleigh St, Guildford, N.S.W. 2161. This has been returned by the postal authorities, after having been readdressed to 7 Aberdeen Crescent, Finden, South Australia, 5023. Would Mr Fletcher please advise his present address.

ACOUSTIC FEEDBACK: I have just built your Playmaster 118 stereo amplifier described in the July '67 issue and have good results. I have installed one speaker, the amplifier and record-player in one cabinet and the other speaker in its own cabinet. As the volume and bass controls are advanced the speaker below the record-player rumbles violently. If I remove the speaker the trouble disappears. Is it the fault of the components? Also when I first switched on the amplifier the anodes of the 6GW8s glowed red and I had to increase the common cathode resistor to 120 ohms to cure it. **(C.L., Moonah, Tas.)**

● The rumble in one channel is caused by acoustic feedback from the loudspeaker into the record player. It has some relationship to the design of cabinet and player but is always a potential problem. It can be minimised by restricting the bass response of the amplifier so that any acoustic feedback is not high enough to become sustained. This is the solution used by the designers of commercial "stereograms" which have the speakers in the same cabinet as the record-player. We are surprised that the 6GW8 anodes overheated and wonder whether the supply voltage was too high or the electrolytic capacitor connected across the common cathode resistor was not leaky or reverse connected. Alternatively, the amplifier may have been oscillating at a supersonic frequency. It should not have been necessary to change the bias resistor.

FREMODYNE: I would like to see a transistorised version of the Fremodyne Four featured as a project to build. **(K.L., Bassendean, W.A.)**

● This project would involve a lot of development time as it would require a completely new design. We have no plans for such a design in the immediate future but will keep your request in mind.

INEXPENSIVE CIRCUITS: I must first congratulate you on what I consider to be the best electronics magazine produced. It is the only magazine that caters for the young beginner and through to the older and more experienced electronics expert. I have a regular order and always look forward to receiving your magazine. Keep up the section "The Serviceman," as through this section I have been able to repair several receivers with similar faults to those described. I am limited in finance and so am wondering if you have any simple inexpensive circuits coming up in future issues. Keep up the excellent work. **(C.P., Yeronga, Qld.)**

● Thank you for your appreciative comments, C.P., we are always glad to hear from readers with comments about the content of our magazine. We do try to cater for a wide range of interests and like to know what our readers think of the magazine. "The Serviceman" will be glad to hear that you find his section so interesting and no doubt will continue to contribute to the magazine for many years to come. We cannot predict what designs will be in future issues, but we are constantly on the lookout for ideas for simple designs which we present as often as practicable.

AMPLIFIER CIRCUIT: In your layout of the Playmaster 115 power amplifier boards (published July 1967) the 25uF electrolytic capacitor and 1K resistor parallel to it should be interchanged, with the positive connection of the electrolytic capacitor facing in the other direction. In this way the power boards conform with the circuit diagram. **(M.G., Mt Lawley, W.A.)**

● While you are correct in detail the layout on the board is technically not in error. The components you refer to are connected in series and the order of connection is immaterial. We would not recommend interchanging the components, just for the sake of having it "right" because the electrolytic will not fit comfortably into the space allocated to the resistor.

AMATEUR LICENCE: Will you publish details for the technical requirements to pass the P.M.G.'s exam for the amateur licence. Also, will you tell me if the following circuits I have designed would be suitable for your "Reader Built It" page: two-transistor regenerative receivers, valve audio amplifier with .05 per cent harmonic distortion at 12W, frequency response 15Hz to 100KHz $\pm\frac{1}{2}$dB; two-valve TRF receiver with 6BL8 and 6GW8. **(M.T., Mortdale, N.S.W.).**

● For the Amateur Operator's Certificate of Proficiency, you will have to pass a written examination in electrical and radio theory and radio regulations, also a Morse code test for sending and receiving at 10 words per minute. A limited licence is available which does not require the applicant to take the Morse code test, but restricts him to operation in the Amateur bands above 52MHz. Copies of previous examination papers are obtainable from the Radio Branch of the P.M.G. We suggest you obtain a copy of the P.M.G. publication "Handbook for Operators of Radio Stations in the Amateur Service," also obtainable from the Radio Branch, price 30c. The Radio Branch in the Sydney area is located at 83 Miller Street, North Sydney, 2060. It is possible that the items you mention may be suitable for use in "Reader Built It," but we cannot say without seeing the circuits. We suggest you send us full details for consideration. We note that you say you have "designed" the circuit. Please note that nothing qualifies for inclusion in "Reader Built It" unless it has also been built and proved in operation.

CATHODE - RAY OSCILLOSCOPE: Could you supply me with any information about a cathode-ray oscilloscope? I have obtained some of your publications on the subject, but the articles run over three months, and I only have the middle article, dated July, 1963. I'm mainly lacking the circuit, layout and approximate cost of building the CRO. **(J.E., Morwell, Vic.).**

● The oscilloscope you are referring to is our "Fully Calibrated CRO" published from June to August, 1963. Copies of each of the articles for this design are available through the Information Service for 20c each. The articles give all essential data for constructing the CRO, except the cost which we never quote as prices of parts vary with brand, supplier, discount arrangements, etc.

When writing, please make sure your address is complete, including the POSTCODE. Addition of the latter will ensure minimum delay in handling your letter. Also make sure that your address is legibly written or, for preference, PRINTED. A significant number of letters are returned to us each month because the original address was incomplete or illegible.

ANSWERS TO

RADIO BOOKS: Could you please let me have some information about books on radio. **(C.J., Narrabri, N.S.W.).**

● We suggest that our "Basic Radio Course" is an ideal book for a beginner interested in radio. This can be obtained through the Information Service for $1.60 including postage. For other beginners' books and for more advanced or specialised reading, we suggest you read our section on "Technical Publications" each month when we review a wide selection of books sent to us.

READER BUILT IT: Could you please tell me where I can get a suitable transformer for the article in Reader Built It in "Electronics Australia" for August, 1968. **(I.C., Croydon, Vic.)**

● Reader Built It articles are designs supplied to us by readers. We do not build up the designs and cannot add anything to the articles as published. We cannot advise on values or types where these are not quoted in the article. By coincidence however, on page 114 of the same issue, a transformer is reviewed from which the required voltages could be obtained between pairs of tappings. It would also appear to have good insulation characteristics.

STARTING IN RADIO: I have a son aged 13 who is showing intense interest in radio and reads every book on the subject that he can. I would greatly appreciate your advice as to how he can pursue the subject as a hobby with the possibility of entering some phase of the subject as an occupation. I would also like to learn the rudiments with him so I can participate with him in his hobby. Would you therefore advise me as to local people to contact for reference on problems, including an introduction to a Brisbane radio amateur. **(B.M., Mt. Gravatt, East Qld.).**

● A suitable textbook for both your son and yourself to learn the essentials of the subject is our "Basic Radio Course" which is obtainable through the Information Service for $1.60 including postage. For general assistance in starting in the hobby of amateur radio, we suggest that you contact the Queensland Divisional Secretary of the Wireless Institute of Australia for details of the W.I.A. Youth Radio Scheme. The address is Box 638J, G.P.O., Brisbane, Qld. 4001.

AMATEUR WEATHER PICTURES: Would you please tell me where I can purchase a copy of RCA "Electronic Age" containing the article "Amateur Weather Pictures," a summary of which appears on page 21 of "Electronics Australia." September. 1968, or the address of the American who wrote the article? **(W.E.B., Yeronga, Qld.)**

● We published the complete article as it originally appeared in RCA "Electronic Age." We suggest that for further information, including the author's address, you contact the Editor, Electronic Age, 30 Rockefeller Plaza, New York, N.Y. 10020, U.S.A.

GUITAR GADGETRY: As a member of a guitar group, I have appreciated the inclusion in "Electronics Australia" of various circuits such as fuzz, vibrato and guitar amplifier circuits. There is an ever increasing demand for electronic gadgets for guitar bands. Could you possibly publish circuits for some of the newer gadgets, such as "wow wow" box, "tone bender" and something used in the record "Sky Pilot" to give a sort of aerated sound. Also the guitar organ, which can imitate a limited number of other instruments at the flick of a switch. The circuits required to change the sinusoidal waveform of guitar to that necessary for other instruments would be very keenly read. **(J.H., Gardenvale, Qld.)**

CORRESPONDENTS—continued

● We are glad to hear that you found the articles on guitar amplifiers and associated items of interest, J.H. We will keep your suggestions for further articles in mind, but must point out that we can devote only a strictly limited amount of time to projects of this nature.

CONVERSION TO STEREO: Many years ago I had an amplifier built based on the Playmaster 2 circuit. This has performed extremely well. I now wish to build a stereo unit, but am reluctant to part with an "old faithful." Is it possible to build another stage to link with my present amplifier to convert it to stereo? A fully transistorised unit would be preferred. Further, your magazine recently published the circuit of a monotone electronic organ—is there another circuit allowing chords to be played? **(K. LeS., Charlestown, N.S.W.)**

● Yes, you could convert your existing amplifier to stereo by the addition of a further complete unit, preferably using the same circuit and preferably interconnecting the two to give a balance control facility and to couple the gain and tone controls. A far simpler solution is to dispose of the "old faithful" for what you can get for it and construct a new stereo amplifier. If you want a transistorised amplifier, the Playmaster 115 (published in April, 1967) would be suitable. Alternatively, the new 10-plus-10 transistorised amplifier may suit you better. Copies of the article describing the 115 may be obtained through the Information Service for 20c.

OLD VALVES: Could you please supply me with some old magazines or the circuit diagrams in which old type valves are used? Nearly all my stock of old valves are in their original cartons. **(J.V.D.S., Cairns, Qld.).**

● Without a detailed (and time-consuming) search through our files, we cannot say which of our earlier circuits would meet your requirements. However, in recent years we have published several designs intended for a mixture of valves and other parts. Among these are "ABC Three" (Feb. 66), "ABC Four" (Mar. 66), "ABC Five" (Aug. 66), "Basic Stereo Amplifier" (June 66), and "Basic Mono Amplifier" (May 67). Copies of the articles may be obtained through the Information Service for 20c each.

COUNTRY DOCTOR: As a country doctor I am sometimes 30 miles away from the local hospital when needed. At weekends, it is necessary to leave a string of messages as to my whereabouts. I have tried to buy a small pocket-sized receiver to "bleep" when a transmitter is used at the hospital but the only equipment I have found so far is a two-way radio and a pageing system which is confined to the capital cities. A two-way radio is expensive but, more importantly, the receiver cannot be carried in the pocket. What I should be happy to pay for is a simple short-wave transmitter acceptable to the Post Office (for which I think I have a very good case) and a pocket sized receiver I can carry when visiting, playing golf or in the car. It would be a great help if three different bleep patterns were available. **("Country Doctor," Dungog, N.S.W.).**

● The installation which would come nearest to meeting your needs would be a regular VHF radiotelephone system, with a transistorised receiver fitted into your car and a portable receiver to carry with you at other times. The equipment would involve considerable expense and would be larger than you might be prepared to tolerate but that is the way things are at the moment. You would probably have no trouble in getting the appropriate licence for such an installation. Hospital pageing systems and industrial - band handie-talkies would be cheaper and smaller but they would not do the job. In fact, we doubt whether any equipment currently available could meet your specifications; you are asking for something that is not technically practicable at present. For further advice, we suggest that you get in touch with the Radio Branch, 83 Miller Street, North Sydney. 2060.

RADIO-INTERCOM ERROR: The circuit on page 53 of the October 1968 issue, illustrating the conversion of a radio receiver to function as an intercom, seems to contain an error. The local speaker is not connected in the "monitor" switch position, as far as I can see. **(D.P., Croydon, 2132.)**

● You are right, D.P.; it's one of those silly little mistakes which periodically slip through, despite all our efforts. Instead of being left unconnected as shown, the third lug of the local speaker switch should be connected to the audio output in parallel with the second lug. Sorry if it caused you any inconvenience, and thanks for writing to let us know!

CIRCUIT ANNUAL: Have you thought of the possibility of issuing an annual of your constructional projects, with perhaps a yearly supplement? This would be of considerable assistance to people like myself who are continually losing the issue they require. Also, have you a transistorised version of your "Fremodyne Four" receiver? **(E.F., Highgate Hill, Qld.).**

● The idea of an annual has come up quite a few times over the years but we seriously doubt that we could recover the very substantial printing costs which would be involved. The other problem is that of coping with anything over and above the production of a monthly magazine. No, we have not as yet produced a transistor equivalent of the Fremodyne Four.

NOISE AND DISTORTION METER: Congratulations on your excellent audio generator in the September issue of "Electronics Australia." However, a generator with such low distortion is of little value if one only has a CRO to observe the result. A noise, distortion and millivoltmeter would seem to be a logical companion for such an instrument. Seeing that your generator has the specifications of a quite expensive commercial instrument, what about an N and D meter comparable with the Hewlett-Packard HP333A? **(G.W., Thornleigh, N.S.W.).**

● We used an HP331A ourselves in the development of the generator but even this simpler unit has specifications which would exceed your likely requirements—and add to complexity and cost. We have considered the possibility of a matching N and D meter and may be able to tackle it at some time in the future. It's largely a matter of available staff and time to do the development.

FET RECEIVER: Would it be possible for the FET Three to receive VHF like the Fremodyne Four? It is able to receive medium and short-wave (570KHz to 30 MHz), and 30 MHz is just below the frequency range of the Fremodyne (30 MHz to 250 MHz). A FET has very high output wattage, so I think it might be possible. **(D.J.A., Balwyn, Vic.)**

● The FET Three cannot be modified to receive VHF. Some FET transistors are capable of operating at these frequencies, but not the type we used in our design. There is no connection between the operating frequency and the power rating of a FET.

SOUND PROJECTORS

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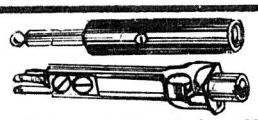

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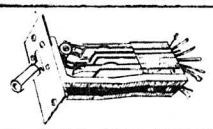

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ANSWERS TO CORRESPONDENTS—continued

STENCIL CUTTER: Something that I would like to suggest is an electronic stencil cutter, which would cut stencils to match original drawings or typing by scanning them simultaneously. The commercial machines are very expensive. I have begun to work on one of my own and, while the mechanical part is easy enough, I have had only limited success with the electronics. My experiments suggest that the scanner and cutter need to work at not less than 200 lines per inch, the drum revolving at about 230 times a minute. Cutting is done by a fine needle with an applied voltage of about 250. The stencil forms part of the DC circuit and the current flowing through it burns small holes in the stencil. The photocell which reads the copy needs to operate to frequencies up to about 11,000Hz, as also does the amplifier controlling the instantaneous potential on the needle. I tried a 6AV6 valve, putting about plus-6V on the grid to reduce the voltage across the valve. This worked but I don't know what the effect on the valve might have been. My other suggestion is to use a thyristor. **(C. McL., Broken Hill, N.S.W.)**

● We must confess that we have never as much as considered such devices until your letter came to hand. We can't make any immediate promises ourselves but the chances are that some reader has worked out a scheme to do what you have in mind. If so, we would like to hear about it, for possible use in the "Reader Built It" feature.

AMATEUR LICENCE: I am preparing to study for an amateur licence and would like to suggest that you publish something similar to "Getting Your Amateur Licence" as presented in 1954. I am sure that this type of article would interest many, and not only intending amateurs. **(R.T., Dandenong, Vic.)**

● We will keep this idea in mind, R.T., but it must be realised that it would be a big undertaking and we cannot promise anything for the immediate future. In the meantime we suggest that the Basic Radio Course may provide part of the answer for those who need to brush up on basic principles as well as the more specific aspects. There are a number of amateur textbooks which can supplement this, such as the A.R.R.L. and R.S.G.B. Handbooks, plus a course from the Wireless Institute of Australia. ■

W.I.A. YOUTH RADIO SCHEME

(Continued from page 157)

Camp Technology 1968-1969

During the summer school holidays the Inter-School Christian Fellowship holds "Camp Technology" at the Scripture Union property, "The Grange," located at Mount Victoria in the Blue Mountains, N.S.W. The camp caters for High school boys interested in electronics and or photography.

The electronics program includes practical projects in the field of amateur radio. The camp operates its own station under the call sign VK2BCT. Audio, tape recording, radio control, computers, electronic music and model railway control systems are also included in the studies.

The technical sessions consist of construction and testing of projects, with instruction by the leaders. A practical and theory program is conducted specifically for those who wish to sit for the W.I.A. Youth Radio Scheme examinations.

The work is organised by men who are qualified in the various subjects and who are willing to share their knowledge and experience with others. Interested secondary school students are invited to contact the Secretary, 239 Elizabeth Street, Sydney, 2000, phone number 80-1264.

Maitland Radio Club

Two senior members of the Maitland Radio Club, R. V. A. Johnson, Principal of the Maitland Technical College, and A. Counsel, passed the August A.O.C.P. examination. These are the first two members to obtain their licence through participating in the club's course of instruction.

The comittee of the club are pleased at the response to the activities associated with the club's participation in the Boy Scout Jamboree-on-the-Air, a total of 80 persons attended the club headquarters in Maize Street, Maitland.

The club station, VK2BHV, made many contacts with Australian Scout groups. The most notable overseas contact was with GB3MLA, one of the official stations in England, located 35 miles from London. Activity on the VHF bands was not very high although the younger visitors enjoyed working VK2ZAP and VK2ZMO. Several Scouts have since joined the club's elementary classes.

To meet the increased interest in the club's activities, courses in theory and Morse code practice are now held each Tuesday evening for those wishing to prepare for the A.O.C.P. examination.

Assistance will be gladly given to anyone interested in amateur radio. All inquiries should be made to the Secretary, Maitland Radio Club, Box 54 P.O., East Maitland, 2323, phone 33-7286.

Inquiries relating to the club's magazine should be made to the Editor, MRC News, at the above address.

Westlakes Radio Club

Ian Miller joined the Westlakes Radio Club three years ago to learn about radio. With the issue of the call sign VK2BJT on October 21, Ian became the youngest fully licensed radio amateur in Australia. A fifth year student at Newcastle Technical High School, his constructional skill and operating ability are reported to be of a very high standard. Seven schoolboy amateurs are now members of the club.

Another five club members have gained Elementary Radio Certificates awarded by the Y.R.C.S. They are: —Honours, with the distinction of over 95 per cent — David Wallace and Robert Day. Credit —Trevor Harris and Terry Parker. Pass to Patrick Scully, who is only 10 years of age.

The club station, VK2ATZ, participated in the VK-ZL-DX contest held in October and made a respectable score of 3,545 points. In all, 20 different prefixes were worked.

The Club Secretary, Bruce Morley, was successful in gaining the A.O.L.C.P. in the August examination.

Tasmania

An increase in Youth Radio Club activity is expected in Tasmania in 1969. Five schools not previously enrolled are expected to register. Active clubs during 1968 were Taroona High School and New Town High School in Hobart; Queechy High School; Deloraine High School; and Marist College, Burnie, in Northern Tasmania.

A group at the Hobart Teachers' College recently affiliated with the scheme. This group in under the leadership of B. L. Jones, VK7TA. They will be making application for their own call sign for the club station.

South Australia

Four members of the Elizabeth Amateur Radio Club gained pass awards and one a credit award in the recent Junior Certificate examination.

In the Elementary Certificate examination at the Port Pirie Youth Radio Club there were four pass, two credit and one honours award made to successful candidates.

An Elementary Certificate examination was held at the end of October for students at the Prince Alfred College Club in Adelaide. This is the first time candidates have been entered for Y.R.S. certificates by the club.

Christmas Island

From Don Reed, VK9DR, comes news of activities at the Christmas Island Radio Club. The club now have the HI-gain 14MHz and 21MHz beams used by Don Miller on his DX-pedition to Cocos Keeling Islands in 1967. The Club stations VK9XI and VK9DR both operate on the South-East Asia net frequency of 14.32 MHz at 1200 GMT for contact with Australia.

A number of club members sat for the special A.O.C.P. examination in September. Don also gave some helpful hints on the construction of Quad antennas, which will be included in next month's notes. ■

BIGGEST AMATEUR RADIO EVENT

(Continued from page 18)

amateurs can afford the Collins, Drake, Swan and National gear that was on show. Heathkit is popular, though, because it caters for that obsession of radio amateurs to "fiddle" and construct, yet it provides the efficiency and versatility and gloss of high-class, commercially manufactured equipment.

Very significant is the growing popularity of imported Japanese gear. Only recently have the Japanese entered the field of amateur communications and there are signs that they will dominate that field within a few years, just as they dominate other electronics markets. Price is the vital issue, of course; price in proportion to quality.

An interesting new British product is the KW Atlanta, the SSB transceiver specially produced for export by KW Electronics Ltd., Britain's biggest manufacturers of amateur equipment. The Atlanta operates 80, 40, 20, 15 and 10 metres, with 400 watts p.e.p. It has an attractive, modern design, refined tuning mechanism and mechanical filter and its price is extremely competitive — £250 sterling.

A gimmick that was selling well was a British-made radar detector instrument, for smelling out police speed traps. Although these have been outlawed in the U.S.A., at the exhibition the police said that their use in Britain was legal!

As an experiment this year, and with a view, perhaps, to turning the exhibition into a full convention, some technical lectures were offered to visitors—on HF communications, SSB equipment, the work of the radio and space research station and SHF systems for communications.

Displays of equipment are fine, technical lectures and symposia are fine, but what the radio amateur wants most at these gatherings is the chance to meet his friends and talk. And talk they do! Here radio amateurs have a chance to put a face to a voice, a voice that may have been disembodied through years of contacts and across thousands of miles. Churchill said "Better jaw-jaw-jaw than war-war-war" and radio amateurs of all nationalities are ardent subscribers to that school of thought!

A recent innovation at the exhibition was introduced because London is the tourist crossroads of the world—an Overseas Visitors' Reception. Each year the attendance at this event increases significantly. This year there were probably at least 100 foreign visitors, the numbers implemented by a charter group of members of the First Class Operators' Club, from the U.S. Experienced amateur radio travellers at the party said this was by far the greatest informal gathering of international radio amateurs that has ever met anywhere! ■

2-NESS OF THE 2

(Continued from page 11)

ments of this work have resulted in the Cyclops II project at the N.P.L., in which the relative positions of "fit" of the n-tuples have been used explicitly to give greater discrimination.

Current investigations are directed towards the development of an economic machine for the recognition of mixed font and hand-printed numerals and capital letters. The n-tuple technique will still be employed, but only to record the small-scale features of a character—corners, lines, crossings, etc. —so that the character can be recognised by a system operating on a list of these features and their relative positions. A little reflection will show that there is a large variety of ways of writing or printing even a simple character like a 2. People may write it with small loops at top or bottom left, and typewriters put serifs and heavy blobs here and there. Figure 1 shows that the often-joked-about N.P.L. standard "2" simply does not exist.

This makes a formal description of the "2-ness of a 2" very difficult, yet it is important to be able to detect this elusive quantity with the hardware of a recognition machine. The mind boggles at the difficulty of reading some of the cursive script which is in everyday circulation, and it looks as though some of these problems are with us for some time to come.

The Cyclops project has led to interesting discoveries in the physiological field, involving the workings of the human eye. Dr Christopher Evans has carried out experiments in which subjects look at a simple diagram of a cross inscribed inside a circle, while a photographic flash bulb is fired. They then close their eyes and look at the after-image on the retina. Instead of disappearing gradually and piecemeal, first one whole arm of the cross, then another, then the remaining two disappear, always in complete units.

Dr Evans believes now, with much experimental evidence to back his theories, that this indicates that the brain builds up its picture out of discrete elements and that these correspond to rows of living cells in the brain which somehow scan and identify lines and other features in the scene presented by the eye just as the Cyclops linear viewer scans writing. Ultimately Dr Evans hopes to learn from the eye itself to help in the design of future reading machines. ■

CRYSTAL CLOCKS

(Continued from page 69)

it would be desirable to have a second dial which could be stopped at the moment a sextant sighting was taken. Facilities would be needed to enable this dial to be reset when the calculations had been made. This is a reasonable request, but we are worried by the natural tendency of most synchronous movements to continue running, for up to one second, after switch-off. Various solutions are being considered.

As an outcome of this extra dial concept, there may be instances where a number of dials are required. This could be done by providing a higher power audio amplifier, capable of supplying the load, and driven from 50Hz from a divider chain.

So far, we have assumed a readout device in the form of a conventional clock dial, either 12 or 24 hour. Of the commercial units available, there appears to be a following of this age-old method, as well as a digital display. We have considered the possibility versus the desirability of a digital display and our reaction has been that the latter, although very desirable in many instances, would be quite complex and costly to produce. In short, we feel that it is not a system which we can consider seriously at this stage and we will concentrate our efforts toward driving a suitable conventional clock dial unit.

This seems to have covered most of the ground as far as reader suggestions are concerned. Suffice to say that provided the suggestion is a reasonable one and can be done technically, without undue complexity, we can see no reason why they could not be provided directly, or made an optional extra. The interest of some staff members here is such that the subject of crystal clocks is being given more than average attention and we hope that results will benefit accordingly. ■

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Advertisements in these columns cost $0.60 per line. Each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lins. Please note: PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES. Your advertisement for the January issue must reach our office before December 5. Address your advertisement to the Advertising Manager, ELECTRONICS Australia, Box 2728, G.P.O., SYDNEY, 2001, N.S.W.

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MODEL RAILWAYS. Rivarossi, Tri-ang, Peco. Promot mail order service. Write for free price lists. Free packing and postage on all orders. P.J.P. Productions, 15 Hamilton St., Gisborne, Vic., 3437.

SELL all back issues, "Electronics Aust." In stock at all times. 1939-56 copies 30c, 57-63 40c, 1964 to date 50c. Post free. T. Weir, 56 O'Connor st., Hoberfield, N.S.W. 2045, Sydney. 789-7569. Wanted to buy copies also.

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GRUNDIG TS340 de luxe 3-speed full stereo. Demo model complete $400. AWA 8-watt amp. mic. $45. Playmaster EF86S preamp., $52. Mullard 10-10 stereo U/L OPTS, $85. Guitar amp. 15W 3 input tremelo, $55. Kuno's TV, Kandos, N.S.W. Phone 77.

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☐ 1. Music is mainly of interest to me as "background", and I enjoy it as such, but do not pay strict attention or wish to spend more than is necessary for the "background" effect. (1,2)

☐ 2. I listen seriously to the melody, rythm and general form of the music, but I am not a hi fi enthusiast. (3,4,6,7,12)

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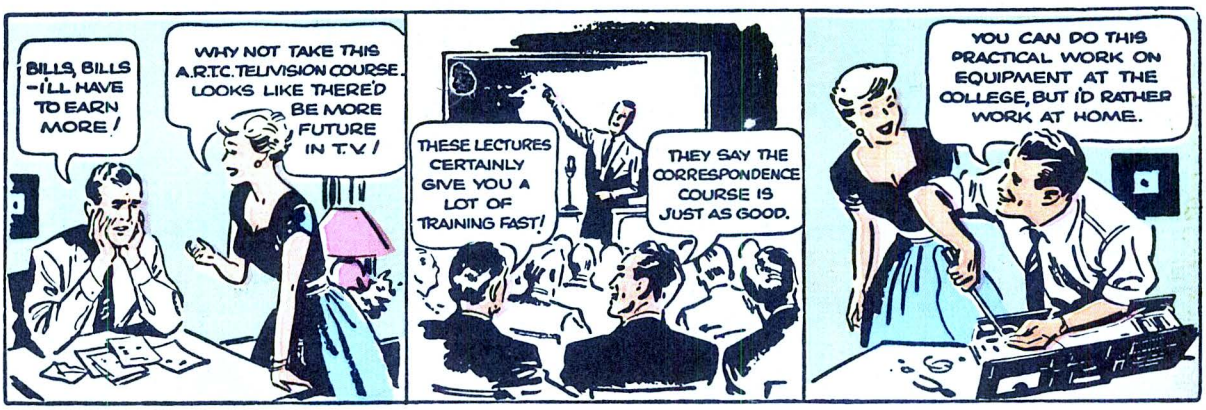

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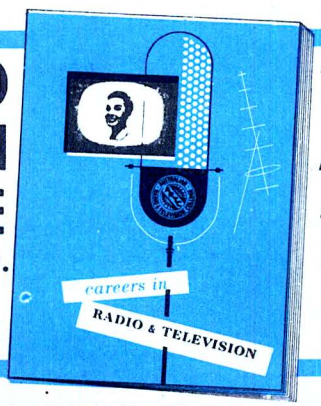

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